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MEDICAL ASPECTS OF HEAD PROTECTION FOR CYCLISTS,

by Lee N. Hames and Elaine A. PetrucelliA 1

Abstract Citation1

MEDICAL ASPECTS OF HEAD PROTECTION FOR CYCLISTS*

by

Lee N. Hames and Elaine A. Petrucelli
American Medical Association

PREFACE

Helmets, as a protective device, have been around for thousands of years, primarily in the field of military activities. More recently, however, they have provided head protection in many other areas, such as contact sports, racing, cycling, and particularly in industry.

Our concern here is with their use in motorcycling. With the advent of lighter, more economical motorcycles, the number of vehicles has increased tremendously. The number of deaths due to motorcycle accidents has risen to about 3,000 per year, and the mortality rate is three times higher than that for automobile crashes.¹ Since the motorcyclist's head most often makes contact with the road, or some other unforgiving surface, in a crash, the need for head protection is obvious.

The question is what kind of protection. It was not until 1957 that a comprehensive testing program was established to set design standards based upon actual performance requirements in a crash situation. Those standards have become the basis for the American National Standards Institute Z90.1 requirement and the Federal Motor Vehicle Safety Standard No. 218, which was adopted on March 1, 1974. These, then, are the protective devices available, and they are what this paper shall discuss.

Motorcycle crash studies, especially concerning the vulnerability of the unprotected head to serious injury, were conducted in England even prior to World War II. This early research indicated that more than 90% of crashes involving head injuries^{2,3} resulted in fatalities. Beginning in 1960, with increased helmet usage, fatalities from head injuries dropped to about

50%.⁴ A general search of the current scientific literature indicates that about 80% of motorcycle-crash injuries are injuries to the head⁵⁻⁷ and that the chance of sustaining a fatal head injury is two-thirds greater for an unhelmeted cyclist.⁸⁻¹⁰ In fact, one study indicates that fatal or serious head injury is three times greater for nonhelmeted motorcyclists.¹¹ Since head injuries almost always present a crucial problem, it is not at all difficult to justify a serious medical interest, to say nothing of the concern of society, both from a humane and a financial viewpoint.¹²⁻¹⁴ This is especially true since the majority of motorcyclists seriously injured or killed are teenagers or young adults.^{5,15}

Physicians and researchers have always been concerned about the overrepresentation of head-related fatalities in motorcycle crashes. The introduction of lighter, less costly cycles, plus the advantage of their use as an economical means of transportation in the present energy crisis, indicates the necessity for even greater concern in the future, as far as numbers of injuries are concerned.

Accordingly, a number of organizations, such as the American Association for Automotive Medicine and the National Safety Council, along with thousands of individual physicians and concerned citizens, have supported mandatory motorcycle helmet legislation. In accordance with the provisions of Highway Safety Program Standard No. 3, most states had passed such legislation. In addition, Australian and Canadian provinces had passed their versions. Some motorcyclists, however, are strongly opposed to any mandatory requirement. In fact, after the U.S. Secretary of Transportation lost the power to enforce the mandatory use of helmets, the motorcyclists, or their representatives, managed to convince a number of states to repeal their mandatory helmet usage laws in 1976, and the trend seems to be continuing.

* Report on the Conference on Medical Aspects of Head Protection for Cyclists, Washington, D.C., April 14, 1977.

We are not concerned here with the arguments used to oppose helmet legislation, except as they relate to questions of morbidity and mortality in motorcycle crashes. However, medical implications have been raised concerning the reliability and efficacy of helmets. It has been claimed, for instance, that helmets do not reduce head injuries, but cause them, and that helmets increase the likelihood of crashes by interfering with vision and hearing. Such claims have been very effective in the fight to repeal helmet legislation, with an accompanying great reduction in helmet usage. Such claims can only be proved or refuted by medical research. They involve complicated questions that must be addressed most carefully and from an objective scientific viewpoint.

Accordingly, the American Medical Association invited a group of experts to a conference in Washington, D.C., on April 14, 1977, to discuss the medical aspects of the overall problem. Although there is interest and need for exploring head protection for drivers and passengers of all motorized cycles, and even those on nonmotorized types, the greatest concern was with the driver and passenger of the motorcycle.

The primary objective of the conference, therefore, was to address, from a medical and scientific viewpoint, a number of issues with medical implications. These included all aspects of helmet usage in which questions of head, neck, and shoulder injuries might be involved. Also addressed were questions of helmets in relation to vision and hearing, the effects of accessories fastened to the helmet, as well as psychological effects.

Conference participation was limited to 21 individuals, mostly physicians and medically oriented researchers with experience and background in this area. Representatives of the motorcyclists, as well as the manufacturers, were invited to give their perspective.

PRESENTATIONS

As an introduction to the meeting, and to provide a background concerning the motorcycle helmet as a protective system, Dr. George Snively gave a brief slide presentation on helmet design, manufacture, and testing. It was pointed out that helmet design, especially in relation to energy absorption capabilities, is not the result of arbitrary decisions, but rather the result of a sophisticated scientific technique with the sole purpose of protecting the head inside the helmet.

The design, of course, assumes that the helmet will be worn properly.

Perhaps too much emphasis has been placed upon the fact that a cyclist enormously increases his chances of staying alive if he wears a helmet, since cyclists in crashes do not always die—the incidence of nonfatal head injury may be 20 times that of fatal head injury. Although such injuries may be nonfatal, they often result in crippling and paraplegia. In addition, they often cause permanent and disabling brain injuries, which often do not appear in the morbidity statistics.

Professor Hugh Hurt gave a slide presentation on the research currently being done by the multidisciplinary accident investigation (MDAI) team at the University of Southern California. Thus far, of the 471 cases studied, there were no injuries to the head (abbreviated injury scale [AIS]=0) in the approximately 40% of cyclists who wore helmets.¹⁶ Even in the two fatalities in the helmeted group, which were caused by severe injuries to other parts of the body, the heads were uninjured. This team is working very closely with the Snell Foundation, which conducts intensive research on helmets involved in crashes to determine the extent of damage to both the shell and liner, and to provide real-life crash data on helmet tolerance to impact.

Dr. James Newman summarized ongoing research in Ottawa, Canada, where mandatory helmet legislation has been enacted. While the great majority of motorcyclists wear helmets, he felt that, on the average, the quality of most helmets generally used in Canada is not as good as the quality of those used in the United States, and that his statistics are not comparable with those in U.S. studies. It is important to note, however, that even where cyclists with helmets received head injuries, the vast majority of those were in the minor to moderate categories ($AIS \leq 2$).¹⁷ He stressed that helmets do not *cause* the injury, but that where injuries result, the helmet spreads the force of the impact, although it is not able to eliminate the force entirely.

Dr. Richard Schultz, a plastic and reconstructive surgeon, showed a slide presentation of persons injured in motorcycle crashes. In every case, a full-face coverage helmet would have prevented or lessened the severe temporal and facial injuries, which usually tend to be of high severity and therefore of great consequence in helmet design.

DISCUSSION OF DIRECT MEDICAL ASPECTS

Cervical Spine

Definitive research directly relating cervical spine injuries to helmet usage is, of course, needed. However, there is no evidence to indicate that motorcycle helmets *cause* the spinal injuries that are occasionally found in helmeted cyclists. Based upon currently available literature,¹⁷⁻¹⁹ personal experiences, and background, cervical spine injuries are possible, whether or not the cyclist is wearing a helmet, depending upon the circumstances of the accident, *but helmets do not of themselves contribute to or worsen the injury.*²⁰

The majority of cervical spine fractures are usually caused by flexion, not hyperextension. As helmet design becomes more sophisticated and more protective of the head, these improvements may increase one's chances of flexion. However, it is obvious that energy not absorbed by the head is not necessarily absorbed by the neck—the principle of energy transfer is much more complex than that.

Currently available evidence indicates that the likelihood of neck injury caused by the helmet is almost impossible, and where it has occurred, the resulting injury has been no more than a minor sprain (AIS=1).¹⁷ And if the forces are strong enough to result in such an impact, they would very likely cause fatal head injury to the unhelmeted cyclist.

The question of head rotation inside the helmet was also considered. There is no evidence to support the contention that a helmet, *if properly fitted and properly worn*, causes head or neck injury as a result of head rotation. Rotation of the helmet itself on certain types of impact was considered. This situation can be a problem in identifying injury attenuation, because in some cases it may appear that the helmet caused the injury, when, in fact, the helmet rotated, exposing the head to injury, and then rotated back to cover the injury. This may occur when the chin strap is worn loosely or is unfastened. However, the helmet itself cannot be held responsible for injuries involving rotation.

Clavicle

During the 1960s, full-facial coverage helmets were banned from racing events in England, because it was suspected that they contributed unnecessarily to clavicle

injuries. However, experience has proved that wearing a helmet is not a factor in clavicle injuries.²¹

Clinical examination of cases involving clavicle injuries indicates that they result from the elbow or arm impacting with an exterior object, thus forcing a transfer of energy to the clavicle. The injury patterns in these cases show clearly that such injuries are not caused by the helmet.

Chin Strap and Chin Cup

Two issues are generally raised during discussion of the chin strap: (1) does the strap itself cause injury?, and (2) is the maximum breaking strength too high?

There was consensus that the chin strap, as now designed, is not a causative factor in neck injury, *if properly worn.*

In regard to the second issue, there is evidence to show that, even at a breaking strength in excess of 600 pounds, which is much greater than the strap loading experienced in most motorcycle crashes, the most significant injury will be a minor abrasion.²²

There is very little data concerning the injury potential of the chin cup itself. Chin cups do, however, move the retention system forward, thereby decreasing the chin strap's ability to retain the helmet during a crash. For this reason, the Safety Helmet Council of America strongly opposes the use of chin cups.²³ They are likewise banned in Great Britain.

Peripheral Vision

Opponents of helmet usage claim that helmet wearing causes a definite serious reduction in peripheral vision. A recent study of the National Highway Traffic Safety Administration has proven that full-coverage helmets, the most common type in use, restrict horizontal peripheral vision by *less than 3%* from that of an unhelmeted cyclist.²⁴ In addition, the full-facial coverage helmet, which complies with both ANSI Z90.1 and FMVSS No. 218, provides a peripheral restriction only slightly greater than that of the full-coverage helmet. Furthermore, *all* approved helmets tested exceeded 180°, well above the minimum required by state licensing agencies for operators of motor vehicles (namely, 140° total peripheral vision in the horizontal plane).²⁴

It was further reported that information obtained from the University of Southern California MDAI team documents that the great majority of crashes

occur well within the 40° field of vision directly to the front of the motorcyclist, thus negating the peripheral vision argument.¹⁶

Should the field of vision be extended in present-day helmets? It was strongly urged that any such extension, since it would necessitate cutting away a larger amount of the helmet and thus afford less protection to the crucial upper facial and temporal areas, therefore adding to the injury rate, should be opposed.

Helmet Weight

Helmet weight varies considerably, depending upon design, construction, and materials used. The weight of the helmet per se, however, is not nearly as important as the center of gravity. If the center of gravity of the helmeted head is basically the same as that of the head itself, the wearer should not experience injury. The situation is not the same as in a motor vehicle crash, where the body is restrained; in motorcycle crashes, the body of the cyclist can move along with the head and neck so the weight added by the helmet will *not* exacerbate the problem. It was stated that automobile race drivers, whose helmet weight was increased considerably several years ago, and where this information is monitored closely, have not shown any increase in neck injuries.

A more important consideration than weight is the thickness of the helmet, since performance upon impact is enormously different in helmets with as little as 1/4-inch difference in thickness.

The possibility of rider fatigue caused by strained neck muscles resulting from heavier helmets was raised. It was pointed out that it is important for a motorcyclist to move his head back and forth continually to stay abreast of the changing traffic environment, but the helmet weight is not sufficient to cause a significant accident potential. In addition, although we do not know of any research to document the effects of heavier versus lighter helmets, there are case studies and personal interviews indicating that riders are able to accommodate easily to any helmet within a several pound differential and do not experience problems directly related to helmet weight.²⁵

Auditory Aspects

As with visual impairment, allegations have been made that helmets seriously impair hearing capability.

Motorcycles can create a noise level of 105 decibels. Obviously, it is necessary that any other sound, in order to be heard by a cyclist, be louder than that re-

sulting from the cycle. Consequently, as long as the rider can hear the motorcycle itself while wearing a helmet, he can also hear any other sound with a favorable signal-to-noise ratio—one greater than 105 decibels.²⁶

The helmet does reduce the loudness of both the sound of interest and the motorcycle noise *proportionately*, but does not alter the signal-to-noise ratio between the two sounds. Critical traffic signals are not lost, and, in fact, may be helped²⁷—when wind noise is minimized, the more critical sounds become louder.

It has been claimed that helmets can cause hearing damage. To the contrary, in the normal traffic stream, the helmeted cyclist is subjected to only 93 decibels in a situation where the unhelmeted cyclist is subjected to 105 decibels. While hearing injury can result from continuous exposure even at the lower rate, the allegation that helmets are responsible for hearing loss is patently false.

DISCUSSION OF RELATED MEDICAL ASPECTS

Alcohol Involvement

A number of recent studies,^{28,29} including one done among military personnel,³⁰ indicate that alcohol is involved in a disproportionate number of motorcycle crashes involving fatalities. In fact, the University of Southern California MDAI team found that alcohol was involved in over 50% of the motorcycle fatalities it is investigating.¹⁶ It was pointed out that alcohol-related motorcycle crashes are very similar to those involving motor vehicles and are far too common, adding tremendously to the problem.

Speed

The University of Southern California MDAI team, through vehicle deformity studies, has indicated that excessive speed is *not* a factor in the majority of motorcycle crashes. In fact, California statistics show that the majority of crashes occur at an average speed of 32 mph.¹⁶ In motorcycle accidents involving excessive speed, the helmet should not be indicted for not affording adequate protection, because, at upper limits, no protective system can be effective.

Effects of Accessories

An increasing number of cyclists are adding accessories to the helmet, many of which are purely for decorative purposes. It was emphasized that any added equipment, such as rearview mirrors or visors

that necessitate drilling holes in the helmet, alters the structural integrity of the helmet and is therefore extremely hazardous. In addition, these effects, if not flexible or breakaway, can have extremely dangerous results upon impact.

Tinted Face Shields/Visors

Many cyclists use tinted face shields or visors that provide full-face coverage. While the intent of these devices is good, the motorcyclist sometimes continues to use them for night or twilight driving as well, and is not always aware of the gradual visual impairment that occurs. Also, certain shades can filter out the color of traffic signals, thus adding a potential hazard. There are at least four accident cases reported in the literature involving darkened visors or tinted shields.¹⁶

Thermal Aspects

There was little argument concerning the fact that the helmet does cause a certain amount of discomfort during warm weather. However, there is no documentation translating this discomfort into increased crash hazard. In fact, in tests conducted in Southern California desert races where ambient temperature reaches 120°F, there actually was a cooling effect in current-design helmets.

Sense of Overconfidence

Some critics have pointed to the fact that a helmet provides the cyclist with a false sense of security, thus encouraging him to take unnecessary risks. Others feel, however, that cyclists who wear helmets, when *not* required by law to do so, are generally safer drivers; conversely, it is probably true also that cyclists who choose not to wear helmets do not associate the danger involved and are willing to take more risks than the helmeted cyclist.

Improper Helmet Removal

There was interest expressed about the possibility of Emergency Medical Service (EMS) and/or ambulance personnel inflicting serious neck injury if they are not trained in how to remove a helmet from an injured cyclist. Two persons should be used; one to place his hands inside the helmet in order to hold the head rigid, and the other to pull the helmet open and remove it.

It was stated that the Department of Transportation has recently revised its training course for EMS paramedics, and a section has been included on proper

helmet removal.³¹ In addition, the Sports Car Club of America also has a monograph on the subject.³²

RECOMMENDATIONS

A number of recommendations are implicit in the foregoing material, but, because of the gravity of the matter, they are set forth here clearly and precisely. The recommendations are based upon the expertise and research experience of the conference attendees, as well as upon a preponderance of evidence in currently available scientific literature. The recommendations are:

1. Every individual who drives or rides a motorcycle *should wear* a properly fitted, approved helmet.
2. Full-facial coverage helmets are strongly recommended, because of the extra protection they afford.
3. Since moped crashes subject victims to the same type of trauma hazards that endanger motorcyclists, moped riders should also wear helmets.
4. Bicyclists would be well-advised to wear helmets, because when involved in a crash with a motor vehicle they are exposed to the same forces a motorcyclist faces.
5. Because of the serious public health implications of the motorcycle accident problem, the medical and public health community should actively involve itself in promoting the use of safety helmets.

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ABSTRACT CITATIONS

SAMPLE ENTRIES

FORMAT OF ENTRIES IN HIGHWAY SAFETY LITERATURE

NHTSA accession number _____ HS-013 124
Title of document _____ **MAXIMUM BRAKE PEDAL FORCES PRODUCED BY
MALE AND FEMALE DRIVERS**
Abstract _____ The object of this research was to obtain data concerning the maximum amount of brake pedal force that automobile drivers were able to sustain over a period of ten seconds. Subjects were told to apply the brakes in the test car as they would in a panic stop, and to exert as much force as possible on the pedal over the entire ten second test period. A total of 84 subjects were tested, including 42 males and 42 females. The results indicated that there is a wide distribution of values which characterizes the pedal force that the subjects were able to generate. Male subjects produced generally higher forces than did females. Over half the women tested were unable to exert more than 150 lbs. of force with either foot alone, but when both feet were applied to the pedal, force levels rose significantly.
Personal author(s) _____ by C. R. VonBuseck
Corporate author (or author's affiliation) _____ General Motors Corp.
Publication date; pagination _____ 1973? ; 18p
Supplementary note _____ Excerpts from Maximum Parking Brake Forces Applied by Male and Female Drivers (EM-23) BY R. L. Bierley, 1965, are included.
Availability _____ Availability: Corporate author

NHTSA accession number _____ HS-018 924
Title of document _____ **NATURAL FREQUENCIES OF THE BIAS TIRE**
Abstract _____ The lowest natural frequencies of a bias tire under inflation pressure are deduced by assuming the bias tire as a composite structure of a bias-laminated, toroidal membrane shell and rigorously taking three displacement components into consideration. The point collocation method is used to solve the derived system of differential equations with variable coefficients. It is found that the lowest natural frequencies calculated for two kinds of bias tire agree well with the corresponding experimental results in a wide range of inflation pressures. Results of the approximate analysis show that the influence of the in-plane inertia forces on natural frequency may be considered small, but the influences of in-plane displacements are large, particularly on the natural frequency of the tire under low inflation pressure.
Personal author(s) _____ by Masami Hirano; Takashi Akasaka
Journal citation _____ Publ: Tire Science and Technology v4 n2 p86-114 (May 1976)
Publication date _____ 1976; 6refs
Availability _____ Availability: See publication

HS-025 091

METHODS OF REDUCING THE SPLASH AND SPRAY HAZARD OF LARGE TRUCKS. FINAL REPORT

The aerodynamics and hydrodynamics of the formation of spray clouds by large trucks which can impair visibility and create hazards for adjacent vehicles have been studied. These processes involve spray generation at the wheels followed by the dispersion of the droplets into spray clouds by the turbulent airflow induced by the vehicle and the natural wind fields. The dispersion prediction requires a knowledge of the aerodynamic flow field surrounding the truck; this is incorporated into a computer program capable of calculating the disposition and density of all spray clouds associated with the vehicle. Because of the inadequacy of theoretical methods of predicting both aerodynamics and spray generation, experimental methods were used to measure relevant data to support analytical models. These methods involved wind-tunnel testing of numerous tractor-trailer rigs (1/10 scale models) including various airflow-modifying devices (primarily fenders and flaps), to measure airflow and turbulence, and field testing of a full-scale, isolated wheel set to measure spray generation features and to study fender effects. For the wheel test, a special instrument was developed to measure droplet size and density. Splash tests were conducted using complete truck configurations at the Firestone test track at Fort Stockton, Tex. Technical conclusions are that the computer model is a cost-effective tool for predicting spray-cloud effects of various trucks and modifications. The tests and analytical methods developed were found to be a very effective approach to understanding the problem and theoretically projecting effects of changes. Operational conclusions are that some add-on devices can ameliorate the spray-cloud dispersion by reducing airflow turbulence and that the optimal splash and spray condition for all truck configurations is achieved by inclusion of an aerodynamic-modification device which suppresses turbulence in the spray-generation region combined with a droplet-suppression device surrounding the wheels, coated inside with material to reduce splashback.

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Pasadena, Calif. 91107
DOT-FH-11-9165
Rept. No. AV-FR-7149; 1978; 158p 17refs
Subcontracted to AeroVironment Inc., subcontract STI-S-1093-1. HS-025 092 contains Appendices; see also HS-025 089, HS-025 090, and HS-025 093.
Availability: Reference copy only

HS-025 092

METHODS OF REDUCING THE SPLASH AND SPRAY HAZARD OF LARGE TRUCKS. APPENDICES. FINAL REPORT

Data are presented from a study investigating the splash and spray clouds created by trucks on wet roads, which included the development of an analytical methodology for aerodynamic flow, splash generation, and droplet cloud propagation, as well as wind-tunnel testing using 1/10 scale models of several truck configurations, and full-scale field tests of isolated truck

wheels and of actual truck rigs. An annotated bibliography is presented, rated in terms of relevancy, on the following topics: aerodynamic flow and force data (full-scale and wind tunnel), aerodynamic devices and drag data, aerodynamic-flow theory and analysis methods, splash and spray data (full-scale and laboratory) for conventional situations, effects of mist, fog, splash, and spray on visibility, and full-scale test instrumentation (aerodynamic, splash, and spray). An interpretation of wind-tunnel flow visualization photographs is presented. A complete analytical development of a model to estimate the amount of water picked up by the wheel and its trajectory (spray model) is provided. Descriptions of test setup, equipment, and procedures, and ambient conditions are presented as well as the test log, and as-run schedule for splash and spray, isolated-wheel field tests. A general description of tests, and data on truck wind-speed and yaw-angle, static-pressure, track-anemometer, water-collection, and flow-visualization are provided for the full-scale splash and spray tests on Firestone's test track facility in Fort Stockton, Tex. Different truck configurations were tested, as well as an aerodynamic device (porous drag shield mounted on tractor) and a spray-collector device (Reddaway flaps used behind all wheels, between the duals, and mounted on all surfaces exposed to direct splash and spray). Data from computer runs of a spray dispersion model for three configurations are provided: (single wheel at front of a 40-ft van, a full configuration with a long-cab-over-engine tractor and a 40-ft van semi-trailer, and the same full configuration with a porous drag shield and Reddaway flaps. The dispersion model theory, description, and documentation are presented.

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DOT-FH-11-9165
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Availability: Reference copy only

HS-025 093

A COST-EFFECTIVENESS EVALUATION OF DEVICES FOR REDUCING THE ADVERSE AERODYNAMIC EFFECTS OF LARGE TRUCKS. FINAL REPORT

An evaluation was made of the cost effectiveness of numerous add-on devices to minimize three aerodynamic-related phenomena affecting motorists in the vicinity of large trucks (truck-induced air force disturbances, splash, and spray). As part of Phase 1 of the work program, a computer program was developed to simulate line-haul truck operations, in order to evaluate efficiently the marginal benefits and costs of numerous add-on devices; the overall structure of the model and all major computational steps, with the exception of the fuel consumption subroutine, are discussed initially (overview, movement simulation, marginal costs, benefit/cost subroutine, and multi-scenario analysis). The subroutine for calculating fuel consumption and travel time is discussed next, the procedure for which has been formulated to be sensitive to basic truck and roadway characteristics and wind conditions;

the major variables that may be examined for their effect on fuel consumption are truck hp, speed, gross vehicle weight, effective cross-sectional area, type of terrain, trip length, and wind speed and direction. Validation of the subroutine procedure (comparison with previously published material), and several examples of its application in this study are discussed. The input data are considered; specific topics include definition of add-on devices (30 described, 25 utilized in program), visibility and drag effects of devices, economic characteristics of devices, weight and power characteristics of basic truck, line-haul operating scenarios, and economic conditions for evaluation. Selected results from the computerized cost-effectiveness computations are presented; patterns of effectiveness and cost are described, and alternative rankings are derived on the basis of overall relative cost-effectiveness, capital cost within ranges of objective effectiveness, and fuel savings within these ranges. Potential off-vehicle countermeasures to reduce aerodynamic effects of large trucks are also discussed, including driver training, operational controls and regulations, and highway design changes.

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Hawthorne, Calif. 90250; Alan M. Voorhees and Associates,
Inc., 7798 Old Springhouse Rd., McLean, Va. 22102
DOT-FH-11-9165
1978; 182p 14refs
See also HS-025 089--HS-025 092.
Availability: Reference copy only

HS-025 094

WHAT THE POLLUTION AUDIT FOUND [SOURCES OF HYDROCARBON EMISSIONS IN THE U.S.]

An EPA-sponsored study (one of four) by a Washington State Univ. air pollution expert, Patrick R. Zimmerman, has revealed that 87.3 million tons (79.2 million mt) a year or 80% of the hydrocarbons (HC) in the U.S. in 1976 were emitted from a wide variety of trees, plants, fallen leaves, soil, and marine areas. Such sources of HC emissions were not mentioned in a 1970 report by the National Air Pollution Control Administration predecessor to the Environmental Protection Agency (EPA), which stated that approximately 32 million tons (29 million mt) of HC were emitted in the U.S. in 1968, of which 15.6 million tons (14.2 million mt) were attributable to motor vehicles. The EPA failed to release the results of Zimmerman's study to the public for fear that they would cause confusion about the agency's nationwide strategy for controlling smog-causing emissions. When Zimmerman was asked by the American Petroleum Inst. (API) to review all available literature on natural air pollution, the EPA declined his request to use some of the above-mentioned research. A Freedom of Information suit by API against EPA has resulted in release of some of the work, but the suit is continuing until all data have been released. Zimmerman's studies of natural pollution are unique in that they measure all the naturally-produced HC in the air. One draft of Zimmerman's report states that the natural HC is almost four times greater than the man-made HC, or 80% of the total HC production, but this statement does not appear in the second draft. In any case, both drafts conclude that natural organic emissions could be an important element in the overall HC burden. A continuing puzzle to Zimmerman and many other researchers is the source for the high ozone levels that are increasingly being found in rural and remote areas. Zimmerman believes that biogenic emissions of HC cannot in themselves account for this, and that natural HC is not a factor in city ozone because the naturally-produced terpene

HC, which can be identified, is seldom found in rural ozone. While Zimmerman does not see a close connection between his findings and the EPA's ozone control program, the API does.

by Joseph M. Callahan
Publ: Automotive Industries v159 n1 p47-50 (Jan 1979)
1979
Availability: See publication

HS-025 095

REAL-TIME, CONTINUOUS MEASUREMENT OF AUTOMOTIVE SULFURIC ACID EMISSIONS

Preliminary work is discussed in which vehicular sulfuric acid (H₂SO₄) emissions were monitored continuously and non-destructively by measuring the surface resistance of filters during collection of H₂SO₄ aerosol generated by an oxidizing catalyst-equipped vehicle. Although electrolytic resistance is not specific for a given species if other ionic species are present, the properties of aqueous H₂SO₄ aerosol are such that as it exists on auto exhaust particulate collection filters, other ionic species, if also present, would not interfere with its determination by a filter resistance method. Initial results have shown the filter resistivity measurement to be a potential useful method for measuring automotive H₂SO₄ emissions. Further work is required to demonstrate that this method is suitable. For example, it is necessary to assess the effects of relative humidity and temperature on filter surface resistance. This could be accomplished by measuring the surface resistance of filters containing known quantities of H₂SO₄ aerosol while these two parameters are varied systematically. This data matrix could be used as a basis for calibration, both temperature and relative humidity were measured simultaneously with resistance during an actual run. Filters other than the glass fiber type and the H₂SO₄ detection limits of the method need to be investigated.

by Morton Beltzer
Publ: Journal of the Air Pollution Control Association v29 n1 p57-9 (Jan 1979)
1979; 14refs
Availability: See publication

HS-025 096

AUTOMOBILE INSURANCE LOSSES. COLLISION COVERAGES. VARIATIONS BY MAKE AND SERIES 1978 MODELS DURING THEIR FIRST YEAR, 1977 MODELS DURING THEIR FIRST TWO YEARS, 1976 MODELS DURING THEIR FIRST THREE YEARS

Variations are reported in frequencies and sizes of collision coverage claims for damage to 1976, 1977, and 1978 model year passenger cars in the U.S., based on data supplied by eight insurance companies (Aetna Casualty and Surety, Allstate, Kemper, Liberty Mutual, Nationwide, Prudential, State Farm, and Travelers). Statistics for 1978 models were based on nearly 650,000 insured vehicle years of exposure, those for 1977 models on 2.8 million insured vehicle years, and those for 1976 models on 4.2 million insured vehicle years. Results are included for vehicle series from 12 domestic and 11 foreign makes. For 1976, 1977, and 1978 models, claim frequency and average loss payments per claim, and average loss payment per insured vehicle year varied greatly with vehicle size. Results for 1977 and 1978 models were highest for subcom-

pacts and lowest for intermediates. For 1976 models, the full-size group had the lowest and the subcompacts had the highest losses. Small cars dominated the 1978 model year exposure (subcompacts and compacts accounting for 66% of total exposure vs. 40% for 1977 model year exposure). For all three model years, the average loss payments in each size group were by far the highest for sports or specialty models; among compact, intermediate, and full-size models, averages were higher for regular two-door vs. four-door models. The claim frequency for 1977 models increased 7% from the first to second year, with average loss payment virtually unchanged. The claim frequency for 1976 models decreased slightly in each successive year, down 1% between first and second years, and down 2% between second and third years, with average loss payment increasing slightly (up 2% and 6%, respectively). Among high-volume 1978 cars (those with 1% or more of total exposure), the Toyota Celica and Pontiac Firebird had the worst loss experience and the Chevrolet Nova two- and four-door models had the best. Among low-volume 1978 cars, the Chevrolet Corvette and Volkswagen Scirocco had the worst loss experience, the Honda Civic station wagon and four-door Oldsmobile Omega having the best. Difference among all cars between best and worst was almost sixfold.

Highway Loss Data Inst., Watergate 600, Washington, D.C. 20037

Rept. No. RR-HLDI-R78-2; 1979; 131p 7refs
Availability: Corporate author

HS-025 097

POTENTIAL FUEL CELL SYSTEMS FOR TRANSPORTATION APPLICATIONS

There have been significant developments in fuel-cell technology since the energy crisis of 1973 which stimulated a reexamination of fuel-cell cars, particularly of the hybrid type. A recent preliminary analysis shows that fuel-cell/battery hybrid vehicles will be markedly superior in performance characteristics to any advanced battery-driven vehicles. Other advantages of fuel cell/battery vehicles are little or no pollutants in exhaust emissions, noiselessness, and reliability (minimum moving parts). A fairly general classification of fuel cells is provided which makes a broad distinction between direct and regenerative cells, which are akin to primary and secondary batteries, and includes a third type, the indirect fuel cell, under which one may categorize reformer and biochemical fuel cells. Since hydrogen is not a primary fuel, in a sense the hydrogen-air fuel cells can be considered under the indirect type. Oxygen, either pure or in air, is used in practically all fuel cell systems. The basic unit of a fuel cell is the single electrochemical cell; the thermodynamic and electrode kinetic aspects of fuel cells are explained. There has been considerable technological progress, particularly in the last 10 years, with the phosphoric acid (United Technologies), alkaline (Siemen), and solid polymer electrolyte (General Electric) fuel cells; a table provides a comparison of the current density, cell voltage, power density, operating temperature, thermal efficiency, catalyst loading, start-up time, and life performance characteristics for these three potential candidate fuel cells as reported in 1967 and in 1977. There has been a significant improvement in start-up times and life of all systems, which is essential for fuel-cell vehicles. There have been marked reductions in noble metal catalyst loading, and therefore less capital cost, for the fuel cells over the decade. The projected weights and volumes of these fuel cells are acceptable for vehicular propulsion systems. In an evaluation of fuels, fuel storage, and

reformers, hydrogen is considered the ideal fuel, and methanol the only other promising possibility. Methanol would cause the least disruption to the present gasoline distribution network, has the best environmental acceptability, and a low (200 degrees C) reformation temperature. Storage for hydrogen as metal hydrides, ammonia or compressed gas has been investigated. Methanol and ammonia are the best fuels for minimizing weight of fuel storage.

by S. Srinivasan
Brookhaven National Lab., Dept. of Energy and Environment, Upton, N.Y. 11973
Rept. No. BNL-24224; CONF-770892--1; 1978; 14p
Presented at Fuel Cell Powered Vehicle Workshop, Los Alamos, N. Mex., 15-17 Aug 1978. Research sponsored by Dept. of Energy.
Availability: Corporate author

HS-025 098

ROAD VEHICLES--VISIBILITY--METHOD FOR ESTABLISHMENT OF EYELLIPSES FOR DRIVER'S EYE LOCATION. 1ST ED.

This International Standard establishes two-dimensional eyellipses representative of driver eye locations corresponding to the 90th, 95th, and 99th percentiles. The eyellipse contours were developed by the statistical analysis of photogrammetric data of drivers' eye locations and represent a population mix, primarily of U.S. licensed drivers, half male and half female. The eyellipse templates are the perimeters of envelopes formed by an infinite number of planes dividing the eye positions so that P% of the eyes are on one side of the plane and (100-P)% are on the other. The 95th percentile eyellipse does not include 95% of the drivers' eye locations. For example, if a plane seen as a straight line in the side view is drawn tangent to the upper edge of the 95th percentile eyellipse, then 95% of the driver eye locations will be below the line and 5% above the line. Conversely, if a plane seen as a straight line in the side view is drawn tangent to the lower edge of the 95th percentile eyellipse, then 95% of the driver eye locations will be above the line and 5% below the line. These straight lines or sight lines are drawn from the object in the driver's field of view tangent to the eyellipse contour. This standard is based on an original study, involving drivers with a straight-ahead viewing task without head turning. A subsequent study has provided a method of accounting for driver viewing targets located at extreme lateral angles from the forward line of sight and accommodates a head movement up to 60 degrees after an eye movement of up to 30 degrees. In a third study, an eyellipse locator line has been developed to position the eyellipse in the driver work space for back angles ranging from 5 degrees to 40 degrees in 1 degree increments. Six plan and side view eyellipse templates are included in the standard, representing six specific normal driving and riding seat track travel lengths ranging from a minimum of 102 mm to a maximum of 165 mm in 12 mm or 13 mm increments. Data are presented for constructing eyellipse template contours and the eyellipse locator line template shape.

International Organization for Standardization, Technical Com. ISO/TC 22, Road Vehicles
Rept. No. ISO-4513-1978-(E); 1978; 13p 7refs
Availability: American National Standards Inst., 1430 Broadway, New York, N.Y. 10018

HS-025 099

HSL 79-09

HS-025 099

**A CATEGORICAL ANALYSIS OF THE
RELATIONSHIP BETWEEN VEHICLE WEIGHT AND
DRIVER INJURY IN AUTOMOBILE ACCIDENTS.
FINAL REPORT**

The effect of vehicle weight on driver injury was examined, using North Carolina accident data for 1973, 1974, and 1975. A descriptive analysis was based on a series of cross-tabulations of driver injury by vehicle weight across various subsets of the data (i.e. single-vehicle crashes, rural crashes, urban two-car crashes, high-speed crashes). As expected, single-vehicle accidents were found to be more serious than two-vehicle accidents, and rural accidents more serious than urban accidents. Increased car weight was clearly shown to lessen the risk of serious or fatal injury for all accident types combined and for two-vehicle crashes. For single-vehicle crashes, a consistent relationship between car weight and driver injury was not found. In order to examine more closely the vehicle weight/driver injury relationship, linear categorical models were constructed for predicting serious driver injury or fatality as a function of vehicle weight and other related variables. Five such models were developed, one for single-vehicle crashes, one for belted drivers in two-car crashes, and three for unbelted drivers in two-car crashes (corresponding to three speed categories). For the single-vehicle crash model, variables used were vehicle weight, region of impact, accident speed, belt use, and driver age. For the two-car crash models, the weight and region of impact for the second car was added to this set, and driver age omitted. For the single-vehicle model, belted drivers were shown to have lower predicted serious injury rates than unbelted drivers, and younger drivers lower rates than older drivers. Drivers in the lightest weight category cars consistently had the highest predicted injury rates, but the other three weight categories were not always differentiated. For the two-car crash models, the vehicle weight categories were differentiated, as expected, for all but low-speed crashes. An added dimension to this analysis is a series of tables showing predicted driver injury rates as a combined function of the weights and regions of impact for both cars in two-car crashes.

by J. Richard Stewart; Jane C. Stutts
University of North Carolina, Hwy. Safety Res. Center,
Chapel Hill, N.C. 27514
DOT-HS-4-00897
1978; 93p 15refs
Rept. for 30 Jun 1977-31 May 1978.
Availability: Corporate author

HS-025 100

**IMPLEMENTATION OF THE MOTOR VEHICLE
INFORMATION AND COST SAVINGS ACT OF 1972**

Title 3 of the Motor Vehicle Information and Cost Savings Act of 1972 (PL 92-513), an attempt by Congress to help the consumer to minimize the cost of automotive repair and maintenance, provided for diagnostic inspection demonstration projects as a base for further legislation, possibly for nationwide mandatory motor vehicle inspection. Out of \$75 million authorized, \$15 million was spent on five demonstration projects. The demonstrations ran for 14 months, ending on 30 Jun 1976, and resulted in no substantive policy recommendations. Nearly a year and a half passed between the date PL 92-513 was signed and implementation of the projects by the National Hwy. Traffic Safety Administration (NHTSA). It took 11 months for the \$15 million to be appropriated, and another six

months for the Office of Management and Budget and the Secretary of Transportation to approve the program. The Congress mandated both start and completion dates for the demonstration projects, and as a result of the initial delay, the projects did not go the intended full term. While the Title 3 effort is limited currently to safety, noise, and emissions inspections performed in high-volume inspection facilities, and to the study of equipment and procedures structured to help the small garage, the scope of the effort has been widening by virtue of the Environmental Protection Agency's inspection/maintenance programs now underway, by virtue of increased interest by the Federal Trade Commission and other agencies, and by virtue of increased interest by consumer and repair industry groups. It is recommended that comprehensive legislation be enacted to amend the Act to accommodate the broader needs of the program, to establish the authority and coordination mechanisms, and to foresee and take measures to avoid or minimize unnecessary delays in implementation. More visibility must be provided by creating an Associate Administrator position in NHTSA solely for the Act, or a new agency such as a Federal Automotive Inspection Registration Agency to address consumer problems. Various newspaper articles on automobile repair are appended.

by James L. Duda
George Washington Univ., School of Public and International
Affairs, Washington, D.C.
1978; 45p refs

Submitted in partial fulfillment of requirements for course PSC
203, Public Policy and Analysis--Focus on Bureaucracy.
Availability: Reference copy only

HS-025 101

**MORBIDITY AND MORTALITY ASSOCIATED WITH
HELMET-WEARING AMONG MOTORCYCLISTS
[NORTH DAKOTA]**

A two-year study (1977-1978) collected and analyzed data on motorcycle accidents in North Dakota, to assess the injury differentials among helmeted and nonhelmeted motorcyclists both in terms of severity and site injury, and to assess the fatality differentials between these two groups. In 1977, the North Dakota State Legislature amended the state's law to require only those motorcyclists under the age of 18 to use helmets (law previously required all riders to wear helmets). The results of the study confirm the observations of other researchers concerning the increased probability of serious injury and death for nonhelmeted motorcyclists. Although total injuries among nonhelmeted motorcyclists outnumbered those of helmeted motorcyclists by a 5 to 4 ratio, the corresponding ratio for head, face, or neck injuries was in the order of 3 to 1. Deaths among nonhelmeted drivers outnumbered deaths among helmeted drivers by over 6 to 1, while total accidents were divided nearly evenly. The study has pointed to a potential need for greater enforcement in operator licensing statutes and perhaps the advisability of instituting a preclicensing safety course requirement. The study also has pointed to the general ineffectiveness of enforcing statutes or standards requiring helmet usage for those under the age of 18. Based on the preliminary findings of this study and other research, it is recommended that Congress and respective state legislatures

be encouraged to adopt and retain mandatory helmet usage laws for operators and passengers of motorcycles.

by Larry Graf; Richard W. Blair; Jonathan B. Weisbuch; Judy Froseth
North Dakota State Dept. of Health; North Dakota Dept. of Highways, Traffic Safety Div.
1978; 29p 6refs
Presented at 106th Annual Meeting of American Public Health Assoc., Injury Control and Emergency Health Services Section, Los Angeles, 17 Oct 1978.
Availability: Reference copy only

HS-025 102

RETURN OF THE ELECTRIC MOTOR VEHICLE

The history of electric vehicles (EV's) in the U.S. is discussed, with particular emphasis on the Dept. of Energy's (DOE) 1978 demonstration program which selected five private companies to produce EV's and hybrid vehicles (HV's) to stimulate public acceptance. Impetus for the DOE program came from the Electric and Hybrid Vehicle Research, Development and Demonstration Act of 1976 which was aimed at developing a substantial market for EV's and HV's by the mid-1980's, thereby reducing the nation's dependence on foreign petroleum sources. The history of EV's in the U.S. from 1833 outlines the development of the first electric motor and electric generator to recharge batteries, early popularity of EV's (first appearing in 1888), and the present battery-powered vehicle population, which consists mostly of off-road vehicle types (e.g. inside-plant "industrial trucks," golf carts). The on-road category includes electric buses, small delivery vehicles, and special-purpose vehicles, in addition to the 2000 electric passenger cars in use in the U.S. today. Past obstacles to growth in on-road EV's include limited travel range because of low-energy density of lead-acid batteries, low acceleration and top speed, and low price and ample supply of gasoline favoring the internal combustion engine. Developments in recent years, when the importance of developing a commercial market for EV's was brought into a sharp focus by the oil embargo of 1973-1974 include demand for a car within the performance limits of present EV's, the Electric Vehicle Council program to design and develop a vehicle for purchase, use, and testing by electric power companies, U.S. Postal Service testing of a fleet of delivery vans, and programs in Japan and Germany. Research in private industry includes auto company programs to produce electric cars and commercial vans in the 1980's and a California laboratory's research on a system for electric power pickup from the roadway. The outlook for public acceptance is favorable. A 1976 study indicates that up to 40% of the U.S. car-buying public would consider purchasing an electric car for city driving if range, price, and operating costs were reasonable. The DOE program is discussed in terms of scope, performance standards for EV's and HV's, recovery of braking energy, and testing of HV's. The special advantages of EV's lie in their reliance on an energy source produced from abundant coal, hydro, nuclear or other means. EV's generate no air pollution or noise and use no energy when stopped in traffic. EV batteries can be recharged at off-peak hours from power plants, which are more efficient for pollution control than gasoline engines.

by Edward A Campbell
Publ: Traffic Quarterly v33 n1 p29-43 (Jan 1979)
1979; 10refs
Availability: See publication

HS-025 103

MOTORCYCLE ACCIDENT PATTERNS IN PENNSYLVANIA

Data on all motorcycle traffic accidents and total traffic accidents in Pennsylvania in 1975, as well as total motor vehicle and motorcycle registrations for the same year, are compared in an effort to identify certain characteristics intrinsic to motorcycle accidents. It is established that most motorcycle accidents occur on dry road surfaces, in clear weather, and during good-weather months. It is indicated that the motorcycle's main use is for leisure-related travel rather than for transportation between home and work. Peak morning motorcycle traffic volumes are only about one-third as high as the peak afternoon volumes. One noticeable difference between patterns of total accidents and those of motorcycle accidents is that motorcycles are seldom involved in rear-end collisions, either as the striking or the struck vehicle. The reason for this appears related to the cycle's small size which allows the driver to position it away from the major travel portion of the traffic lane to reduce chances of being struck from behind, and allows the driver greater ability to swerve to one side when facing the prospect of striking a vehicle ahead. Another reason may be that cyclists have the opportunity to abandon their vehicles rather than accept a collision. Data on angle collisions adds support to the belief that the motorcycle's small size creates perceptual problems for motorists, who may misjudge the speed or distance of the motorcycle or who may fail to see it entirely. The decline in angle collisions involving motorcycles at night tends to support the "misleading size" theory (i.e. size cues minimized or eliminated at night). Motorcycles are overrepresented in accidents on curved highway segments. Involved and offending drivers in the under-35 age group within the distribution of motorcycle accidents comprise a much higher percentage than the two groups of drivers in the distribution of all accidents. Those in the motorcycle distribution, however, develop a favorable involved/offending ratio earlier than do drivers involved in all accidents. Males are overrepresented in motorcycle distribution for both offending and involved drivers, but have a better involved/offending ratio than do females (the latter statistic the opposite of distribution for all accidents). Angle collision and fixed-object collision account for over 3/4 of urban motorcycle accidents; these two types plus the noncollision accident account for most rural accidents, which are much more severe because of higher speeds.

by Stanley F. Polanis
Publ: Traffic Quarterly v33 n1 p139-55 (Jan 1979)
1979; 8refs
Availability: See publication

HS-025 104

BRAKE COMPATIBILITY BETWEEN TRACTOR UNITS AND SEMITRAILERS (BREMSEN-KOMPATIBILITÄT ZWISCHEN SATTELZUGMASCHINEN UND -ANHÄNGERN)

The Economic Commission for Europe (ECE) and the European Economic Community (EEC) have developed braking requirements for articulated vehicles (tractor-trailers), and calculations and evaluations have been made regarding each regulation in terms of average distributions of braking forces for tractor-trailers on roads in the Federal Republic of Germany, using three representative tractor-trailers. ECE Regulation No.

13 stipulates how braking forces must be distributed on "axles" and "vehicles" in order to achieve optimum braking for all conditions of loading for trucks, tractor units, and semitrailers. According to the ECE regulation, braking is established as a function of pressure in the brakeline; allowable tolerances are defined and are identical for empty and loaded vehicles. The EEC Directive 75/524/EEC proposes different tolerances for the different load states. It is concluded that the ECE regulation works well and has the advantage of its requirements being met using commercially-available brake equipment.

by Max Krugel; Hansjürgen Hoffman
Publ: ATZ Automobiltechnische Zeitschrift v80 n5 p207-10 (May 1978)
1978; 14p
Translated from German (original 4p; translation 10p).
Availability: Reference copy only

HS-025 105

CALCULATION OF THE FLOW AROUND THE VEHICLE IN ACCORDANCE WITH THE PANEL PROCEDURE (BERECHNUNG DER UMSTROMUNG EINES FAHRZEUGES NACH DEM PANEL-VERFAHREN)

A theoretical approach to the determination of the airflow around a vehicle is presented. This approach applies theoretical methods utilized in routine aircraft design work to vehicle aerodynamics. The flow around a vehicle is calculated using the "panel procedure" which treats frictionless flow. The pressure distribution around a vehicle model, i.e. around a geometrically-simplified VW bus, is calculated and compared with results of wind-tunnel tests using a 1:4 vehicle model. Good agreement between theoretical and experimental results is found for all areas of attached flow. Large discrepancies occurring when flow separation is involved are to be expected because the theory neglects viscous effects which cause flow separation.

by Syed Rafeeq Ahmed; Wolf-H. Hucho
Publ: ATZ Automobiltechnische Zeitschrift v80 n5 p183-6 (May 1978)
1978; 16p 8refs
Translated from German (original 4p; translation 12p).
Availability: Reference copy only

HS-025 106

EXHAUST EMISSIONS AND FUEL CONSUMPTION IN THE WARM-UP OF GASOLINE ENGINES (SCHADSTOFFEMISSIONEN UND KRAFTSTOFFVERBRAUCH BEIM WARMLAUF VON VERGASERMOTOREN)

Experimental work has been conducted to examine ways of reducing exhaust emission concentrations and volumes, and fuel consumption in warm-up phase operation of a four-cylinder gasoline engine (Audi). Exhaust gas recirculation is shown to be effective in rapidly heating the air-fuel (A/F) mixture, resulting in improved A/F mixing and distribution with associated reductions in carbon monoxide and hydrocarbon exhaust emissions, without affecting the usual smooth running of the engine. The use of multigrade class oil (e.g. SAE 10W50) vs. a regular class oil (e.g. SAE 30) and means to heat up the engine lubricant more rapidly are shown to decrease

friction during the warm-up period and thus decrease fuel consumption and exhaust gas volume.

by Franz Moser; Hans Peter Lenz
Publ: ATZ Automobiltechnische Zeitschrift v80 n9 p393-7 (Sep 1978)
1978; 19p 13refs
Translated from German (original 5p; translation 14p).
Availability: Reference copy only

HS-025 107

TORSIONAL VIBRATIONS IN COMMERCIAL VEHICLES. PT.1 (TORSIONSSCHWINGUNGSUNTERSUCHUNGEN BEI NUTZFAHRZEUGEN. TEIL 1)

In the first part of a discussion of torsional vibrations of commercial vehicles, theoretical consideration is given to the parameters used in vibrational analysis, the natural frequencies, and the sources of vibration in a truck driveline. The driveline of a commercial vehicle consists of engine, clutch, gearbox, universal joint-propeller shaft, axle, and tires. The driveline is subject to torsional vibrations which, in some cases, may be serious enough to result in component failure and excessive noise levels. The causes of critical vibrations are, in most cases, external to the gearbox. Numerous theoretical studies of the vibration problems associated with the individual assemblies in the truck driveline are reviewed, as well as computer programs for calculating the torsional vibrations.

by Eugen Lauster; Wolfgang Maier
Publ: ATZ Automobiltechnische Zeitschrift v80 n7/8 p359-62, 365 (Jul-Aug 1978)
1978; 18p 17refs
Translated from German (original 5p; translation 13p). Pt. 2 is HS-025 108.
Availability: Reference copy only

HS-025 108

TORSIONAL VIBRATIONS ON COMMERCIAL VEHICLES. PT. 2 (TORSIONSSCHWINGUNGSUNTERSUCHUNGEN BEI NUTZFAHRZEUGEN. TEIL 2)

In the second part of a discussion of torsional vibrations of commercial vehicles, methods and instrumentation for measuring vibrations in truck drivelines are considered. Vibratory motion and additional torque due to vibrations are addressed. An example is presented of a vibrational analysis of a truck which considers the vibratory paths of the engine flywheel and gearbox output shaft flange during operation at 1850 rpm. Following a determination of the cause of the vibration problem by appropriate measurements and calculations, which were found to be in satisfactory agreement, an analysis of means to improve the vibration behavior was carried out using a computer program in which the original inputs for transmission, rigidity of clutch, and engine timing sequence were changed.

by Eugen Lauster; Wolfgang Maier
Publ: ATZ Automobiltechnische Zeitschrift v80 n9 p417-21 (Sep 1978)
1978; 17p 1ref
Translated from German (original 5p; translation 12p). Part 1 is HS-024 107.
Availability: Reference copy only

HS-025 109

COMPUTERIZED OPTIMIZATION OF CAR-TO-CAR SAFETY CHARACTERISTICS FOR THE NEW AUDI 80 (RECHNERISCHE OPTIMIERUNG DER SELBST-UND PARTNERSCHUTZEIGENSCHAFTEN BEIM NEUEN AUDI 80)

The accident protection characteristics of an automobile should be relevant to the automobile population of which the vehicle will be a part. A procedure is described which permits optimization, at an early stage of development, of the structural characteristics of a car's front end for protection against the most frequently occurring car-to-car collisions. The procedure was applied for the first time using the new Audi 80, for which the maximum protection afforded by the car itself and car-to-car protection as well, were achieved. Using a market analysis and 1977 vehicle registration statistics for the Federal Republic of Germany, the relative total frequency of various types of vehicles as a function of weight, and the relative total frequency of various types of vehicles as a function of maximum front-end deformation in a 50 kph crash were determined. A simple collision model was developed which takes into consideration the vehicle-specific parameters of weight and front-end rigidity. Using this model, the head-on collision of a particular vehicle with all other possible vehicles is simulated, taking into account collision speeds (as obtained from accident statistics) and accident rates (obtained from vehicle registration statistics). The results permit the evaluation of the effective protection of the vehicle itself and the effective car-to-car protection.

by Reinhard Wagner

Publ: ATZ Automobiltechnische Zeitschrift v80 n10 p455-6,

459-60 (Oct 1978)

1978; 18p 6refs

Translated from German (original 4p; translation 14p).

Availability: Reference copy only

HS-025 110

EFFECT OF FOULING OF HEADLIGHT DIFFRACTION LENSES ON THE DRIVER'S RANGE OF VISION (EINFLUSS DER VERSCHMUTZUNG VON SCHEINWERFER-STREUSCHEIBEN AUF DIE SEHWEITE VON KRAFTFAHRERN)

The driver's range of vision at night can be greatly affected by fouling of the headlight diffraction lenses. This fouling causes some increased blinding of oncoming traffic, due to the light deflection through the dirt, along with a decrease in the light projected from the headlight. The effect of diffraction lens fouling on headlight light distribution and thus on the driver's range of vision is described. In encountering oncoming traffic (depending on road conditions), the reduction in driver range of vision, due to the fouling of the headlight diffraction lenses, is so great that safe night driving is no longer possible.

by Schmidt-Clausen

Westfälische Metall Industrie KG, Hueck and Co., Postfach

604, 4780 Lippstadt, Germany

1978?; 43p 4refs

Translated from German (original 23p; translation 20p).

Availability: Reference copy only

HS-025 111

SUREST WAY TO CUT CAR REPAIR BILLS. KNOW WHAT YOUR CAR IS TELLING YOU AND WHAT YOU SHOULD TELL THE MECHANIC

Approaches are outlined for reducing the costs of repairing one's automobile. The first step is to follow the maintenance schedule in the owner's manual to get general guidelines on when to order a tune-up, have the emissions equipment checked, and replace belts, hoses, and coolant, and to follow special requirements for severe service (e.g. more frequent oil change). A list of some fairly common noises and their probable causes is provided (a squeal under the hood, a squeak when braking, roaring or growling from the rear wheels, knocking or rattling under acceleration, noisy gears and difficult shifting, loud or erratic shifts, rattling around the wheels). The more aware one is of the normal sounds and handling of one's car the better one can detect clues to impending trouble. It is advantageous to be able to describe methodically the symptoms of the problem instead of diagnosing the problem oneself and telling the mechanic what needs to be done. A separate section provides a list of typical car repair price ranges for brakes, tune-up, replacing the carburetor, replacing the water pump, overhauling the transmission, replacing hoses and belts, aligning the front end, replacing the rear-axle bearings, and repairing the differential.

Publ: Changing Times p11-3 (Sep 1978)

1978

Availability: See publication

HS-025 112

TEXAS MOTOR VEHICLE LAWS. 1977-1978

Motor vehicle laws for 1977-1978 relating to registration of private and commercial vehicles, certificate of title, abandoned vehicles, operation of vehicles, motor carriers, the uniform act regulating traffic on highways, miscellaneous offenses, driver's licenses, and safety and responsibility are presented for the State of Texas. A subject index is provided by page and article number.

Texas Dept. of Public Safety, Austin, Tex. 78773

1978?; 417p

Availability: Corporate author

HS-025 113

THE PRODUCTIVITY DILEMMA. ROADBLOCK TO INNOVATION IN THE AUTOMOBILE INDUSTRY

An analysis of innovation, productivity, and process change within a firm shows how innovation shapes the course of industrial progress but is, in turn, directed and then subdued by the competitive pressures within a firm. A general, if unorthodox, view of innovation is argued and then illustrated with specific evidence about innovation, productivity, and process change in the U.S. automobile industry (in particular, the Ford Motor Co.) and the pressures that have brought about change. This point of view is decidedly that of the general manager or strategic planner within a firm, but analysts and policymakers within government who wish to understand the pressures that affect technological changes in industry also find merit in the concepts. The dilemma of innovation vs. productivity is outlined in terms of the present analy-

sis and prior research. An historical overview of technological change in the U.S. auto industry is presented. Twenty automotive innovations are analyzed in order to clarify the way they have shaped the course of development of major automotive components and attendant production processes. A general model is presented which captures important milestones of change in the development of a product and its manufacturing process, from inception to maturity, over an economic life cycle. The model is illustrated and refined through an account of technological change in the auto industry. A comparative analysis of two very different products and processes that coexist in each major firm, the automotive engine plant and the assembly plant, is made in terms of the model and reveals much about technological change in general and the auto industry in particular. Appended are the 20 case studies; a chronology of Ford cars, bodies, and engines; data sources for equipment and process characteristics; and assembly plant utilization and car allocation data.

by William J. Abernathy

NSF-DA-20571

1978; 276p refs

Sponsored in part by Harvard Business School.

Availability: Johns Hopkins Univ. Press, Baltimore, Md. 21218

HS-025 114

THE MICHIGAN SCHOOL BUS DRIVER'S MANUAL. A GUIDE FOR PROFESSIONAL SCHOOL BUS DRIVERS. 2ND ED.

As a basic reference for safe bus operation and for use in instructional programs, information is selected from the Michigan Vehicle Code, Michigan Dept. of Education publications and other manuals dealing with pupil transportation. The material covers selection of the driver, legal requirements, personnel and public relations, the driver's responsibilities, care and proper operation of the vehicle, control of passengers, route planning and driving procedures, state and school district driving policies, and law relating to the vehicle, the driver, signs and signals, and rules of the road.

by Paul E. Linebaugh, ed.

Michigan School Bus Driver Safety Education Prog.,
Instructional Staff Com.

1976; 85p

Availability: Automobile Club of Mich., Safety and Traffic
Engineering Dept., Dearborn, Mich. 48126

HS-025 115

MICHIGAN SAFETY BELT PROJECT REPORT

A campaign was undertaken to stress the positive values of using safety belts. Weaknesses of previous campaigns were thought to be a reliance on only one medium (television), and a morbid approach. The aim was to alter the balance between perceived risk and loss as against the perceived nuisance of using belts, modifying attitudes by providing additional information. Using television and radio, the theme "Somebody Needs You" was presented in a series of commercials with a warm friendly tone combined with unemotional facts about automobile safety. A six-week pilot project in the Grand Rapids area produced significant changes in attitudes reported, and was followed by a nine-week test in Michigan, including Detroit. Radio was the dominant medium, with support from television, outdoor and bus cards, and one small ad per week

in local papers. In addition to attitudinal surveys, actual safety belt use was measured. Teams of observers at 224 intersections reported on over 42,000 cars; a significant increase in belt usage was found. The increase varied among segments of the population and areas; maps illustrate these variations. The Detroit test program was not only successful, but attracted much community support and recognition, including many awards. Among the conclusions are that advertising messages are especially effective among certain groups, that the most effective changes seem to result from the most concentrated advertising, and that a diversified media mix seems to increase the campaign's effectiveness. Success of the program demonstrated that a mass communications program with the right theme, adequately financed and professionally implemented, can persuade people to wear safety belts.

Motorists Information, Inc., 519 New Center Bldg., Detroit,
Mich. 48202

1978; 24p

Availability: Corporate author

HS-025 116

ISUZU'S NEW 5.8L DIRECT INJECTION DIESEL ENGINE

A new 6-cylinder, inline diesel engine is described, which has been developed to power medium-sized trucks and for industrial applications, and which is currently in monthly production of 2000 units. Design criteria for the engine include sufficient power output to meet 8-12 ton gross vehicle weight performance requirements, adaptability to domestic and foreign applications, high fuel economy, improvements in reliability and durability, improvements in noise and exhaust emissions control, maximum interchangeability of engine components, and availability of new varied options (gear driven oil pump for power steering, Freon compressor for air conditioning, gear driven air compressor for brake, full power take-off at flywheel housing, engine tachometer, high capacity (1.5 kw) generator, and automatic transmission). The engine is characterized by the use of direct fuel injection system, square to-roidal combustion chamber, glow plugs as a starting aid, thin dry chrome-plated cylinder liners, an engine stop system using air shutter, and a newly developed variable speed RLD-K governor with torque control cam, all of which are discussed from aspects of design and experiment, with detailed photographs, graphs and diagrams. Also covered are the family engine concept and emission and noise control approaches.

by Yasuhira Arai; Yoshitaka Yoshida; Masafumi Matsushita
Isuzu Motors Ltd., Japan

Rept. No. SAE-780349; 1978; 24p

Technical Paper Series. Presented at Congress and Exposition,
Detroit, 27 Feb-3 Mar 1978.

Availability: SAE

HS-025 117

CYCLE OWNERSHIP AND USE IN GREAT BRITAIN

Information currently available on pedal cycle ownership and use in Great Britain is analyzed to give an outline of the travel patterns and characteristics of cyclists and of factors affecting cycle travel. Included are data on distribution of cycle traffic over various types of road, personal-injury accidents to cyclists, and variations in household cycle ownership. A decline in pedal cycle use from 1956 to 1974 has been

reversed, with indications that children contribute a large part of this increase; children up to nine years form an increasing proportion of the total fatal and serious cyclist casualties. The journey purpose for which the cycle was used most was for going to and from work. Ownership is higher in households with several children, in car-owning households, in small towns and rural areas, and in the south and east of Britain.

by A. Stores
Transport and Road Res. Lab., Access and Mobility Div.,
Crowthorne, Berks., England
Rept. No. TRRL-LR-843; 1978; 43p 19refs
Availability: Corporate author

HS-025 118

THE IMPAIRED-DRIVER PROBLEM VS THE IMPAIRED PROBLEM-DRIVER

Impaired driving should be considered as a complex phenomenon, involving different types of drivers at different levels of risk; alcohol increases the level of risk for these drivers, but does so differentially. Roadside surveys have established that although the most frequently impaired driver on the highway is in the age range 30-34, this group is at lowest risk of fatal collision. Those drivers who are excessively impaired or the very young drivers who are moderately impaired are at serious risk of fatal collision, but occur infrequently in the population at risk. Thus detection and apprehension is more probable for those in the large group at lowest risk of collision. Development of a successful predictive and preventive system depends on recognition of these variables.

by Herb M. Simpson
Publ: Transactions of the Association of Life Insurance
Medical Directors of America v61 p178-92 (1977)
1977

Sponsored by Non-Medical Use of Drugs Directorate, Health
and Welfare Canada, and Motor Vehicle Manufacturers'
Assoc.

Availability: See publication

HS-025 119

ANALYTICAL STUDY OF MATHEMATICAL MODELS OF THE MOTOR VEHICLE SYSTEM: PHASE 3. FINAL REPORT

An examination was made of mathematical models to be used in formulating policy relating to the motor vehicle transportation system. The technical approach and research results of four basic tasks are summarized: the collection and inventory of mathematical models of the motor vehicle system, analysis of selected models used in policy analysis, the computer implementation of models being analyzed, and research into the use of a model as a tool in policy formation. The subject of in-depth study was the Wharton Econometric Forecasting Associates (EFA) Automobile Demand Model; its conceptual, structural and operational characteristics were examined and it was tested in operation. Primary uses of the model by the Federal government have been in analyses related to energy policy issues, e.g. the 1981-1984 passenger automobile fuel economy standards and the President's proposed gas guzzler tax, as well as analyses of vehicle emission standards, safety standards, and new engine technology. Although model results have been prominent and have exerted some influence on con-

clusions, few analysts seem to have a deep understanding of the model and its significant limitations, and some projections were subject to large error. Further assessments will be made in 1979, including analysis of the Faucett Automobile Sector Forecasting Model, study of a version of the Wharton EFA model including light trucks and vans, and of the integrated Wharton EFA/Faucett model planned by the Dept. of Energy.

by Barbara C. Richardson; Kent B. Joscelyn
University of Michigan, Hwy. Safety Res. Inst., 2901 Baxter
Rd., Ann Arbor, Mich. 48109
Rept. No. UM-HSRI-78-54; 1978; 41p 8refs
Rept. for Jul 1977-Nov 1978. Sponsored by Motor Vehicle
Manufacturers Assoc.
Availability: Corporate author

HS-025 120

MINIMUM REQUIREMENTS FOR CONSTRUCTION AND EQUIPMENT OF MOPEDS. REGULATION VESC-17

Purpose of the regulation is to establish performance and equipment requirements for the manufacture, sale and safe operation of a moped for use on public highways, and to furnish administrators with a guide for registration eligibility. The regulation sets forth maximum performance and minimum equipment requirements for safe operation of a moped manufactured after the date of the regulation; a jurisdiction may grant exceptions from the requirements, or may permit or require use of other equipment. Moped is defined and regulated components are itemized. Items covered include brakes, tires and wheel rims, steering, fuel and exhaust systems, seat or saddle, chain and belt guards, vehicle stand, controls, audible signaling device, width, lighting equipment, headlamp indicator light, and the requirement of a certificate of compliance for any equipment specified or optionally installed.

Vehicle Equipment Safety Commission, Suite 908, 1030 15th
St., N.W., Washington, D.C., 20005
Rept. No. VESC-17; 1977; 8p
Availability: Corporate author

HS-025 121

MINIMUM REQUIREMENTS FOR CONSTRUCTION AND EQUIPMENT OF SPECIAL MOTOR VEHICLES. REGULATION VESC-12

Purpose of the regulation is to establish equipment requirements for the manufacture of special motor vehicles, or the assembly and construction of vehicles from new or used parts or kits, or the alteration of a motor vehicle which places it in the category of a special motor vehicle, and to establish minimum construction and performance requirements conducive to sound engineering and operational safety. The regulation sets forth performance and equipment requirements for special motor vehicles manufactured after the date of the regulation; a jurisdiction may grant exceptions from the requirements or permit use of other equipment. The regulation does not apply to vehicles modified for the handicapped. Special motor vehicles are defined and regulated components itemized. Items covered include body requirements (defroster and defogging device, door latches, enclosed passenger compartment, floor pan, glazing, driver visibility, hood latches, instrumentation, rearview mirror, seat belts and windshield wipers); chassis requirements (accelerator control systems, brakes,

bumpers, exhaust and fuel systems, fenders, frame, steering and suspension, and tires); and electrical system requirements (dimmer, hazard warning and headlamp switches, headlamp system, high beam indicator, horn, license plate lamp, neutral safety switch, parking lamps, reflex reflectors, stop lamps, tail lamp system, turn signal indicator, turning signal lamps, and turn signal switch).

Vehicle Equipment Safety Commission, Suite 908, 1030 15th St., N.W., Washington, D.C. 20005
Rept. No. VESC-12; 1978; 18p 20refs
Availability: Corporate author

HS-025 122

**COSTS AND BENEFITS OF GENERAL SPEED LIMITS (MAXIMUM AND MINIMUM SPEEDS).
REPORT OF THE ROUND TABLE ON TRANSPORT ECONOMICS (37TH) HELD IN PARIS ON 24TH AND 25TH FEBRUARY, 1977**

Pros and cons of general speed limits, scientific investigation of the expected connection between a general speed limit and safety and ease of driving (i.e. degree of physical effort and psychological strain on driver, duration of travel), and cost-benefit analysis of general speed limits are addressed on an international level. Various national studies indicate that speed limits undoubtedly help to reduce energy consumption. Bearing in mind energy considerations, speed limits outside urban areas should in no case be set below what are regarded as optimum thresholds for traffic flow, i.e. 60 kph to 80 kph, depending on the type of road. Optimum speed from an energy conservation angle alone lies in the region of 80 kph to 90 kph. All the studies conducted in various countries plainly show that the number and severity of accidents are reduced, sometimes to a considerable degree, on all roads where excessive speeds have been reduced by speed limits. Findings based on experiments in various countries are very consistent in showing that actual traveling time in open country (accounting for less than 80% of total journey time) is affected only to a limited extent (5% to 8%) by speed limits. Speed limits do not generate significant intermodal transfers to the detriment of road transport, nor do studies suggest that speed limits have important effects on the motor industry, except for a few small firms specializing in sports cars. It is concluded that studies conducted to examine a single effect of speed limits must be supplemented by studies on their overall effect. Cost-benefit analyses conducted in some countries have been scarce and inadequate. More research on overall appraisal methods is needed, directed particularly to methods based on multicriteria analysis. Existing studies indicate that speed limits have a beneficial effect on road safety and the environment. Among the recommendations for the practical application of speed limits is determination of the optimum speed level with consideration for compliance, monitoring, and enforcement. To ensure compliance, information on speed limits must be supplied drivers in advance, speed limits should be uniform by class of road, and speed limit policy should be internationally uniform.

by K. Krell; R. Ernst; K.-H. Lenz
Bundesanstalt für Strassenwesen, Postfach 51 05 30, 5
Cologne 51, Germany
Rept. No. ECMT-Round-Table-37; 1978; 96p 37refs
Availability: OECD Publications Center, Suite 1207, 1750
Pennsylvania Ave., N.W., Washington, D.C. 20006 \$3.75

HS-025 123

DRIVER INSTRUCTION

The various types of driver instruction and the relationship between driver instruction and traffic safety are discussed, in order to identify skills needed to drive safely, to make a comparative analysis and evaluation of driver education and examination methods now in use and to make recommendations for improved driver education programs. A section of the report is devoted to driver task analysis research as the theoretical basis for improving driver instruction objectives. An overview of existing research in the field of driver education is given and an attempt is made to convert task analysis research into practical training objectives. The content of driver training, teaching principles, methods and aids are discussed and testing methods related to examination and for controlling the existing driver instruction systems is presented. An essential finding of the study is that at present, in most countries, driver education is based on vague foundations, intuitive concepts of the driver task, and objectives not specific enough to contribute to effective program development and evaluation. It is believed that education and testing must be integrated. National efforts should be made to establish basic foundations of driver education. It is suggested that a new special subject be introduced to familiarize the learning driver with risks and how to avoid or handle them (classroom and practical instruction). Recommendations are made concerning examination requirements, the establishment of an international data and documentation bank in this field, the creation of experimental psychopedagogical centers, and conduct of future research on the training of instructors, in-car instruction style, content of instruction, and on-the-road tests. A list of OECD (Organisation for Economic Cooperation and Development) Road Res. Group publications is appended.

by G. Kroj, ed.
Organisation for Economic Co-operation and Devel., Road Res. Group on Driver Education and Training, 2, rue Andre-Pascal, 75775 Paris Cedex 16, France
1976; 107p 197refs
Availability: OECD Publications Center, Suite 1207, 1750
Pennsylvania Ave., N.W., Washington, D.C. 20006 \$5.50

HS-025 124

SAFETY OF TWO-WHEELERS

The problem of prevention of accidents involving users of two-wheeled vehicles is examined. Trends in two-wheeler accidents are presented, with a review of the present research; basic related data are given, and a review of legal aspects is tabulated for OECD (Organisation for Economic Cooperation and Development) participating countries. An analysis of accidents follows, with a study of contributory factors, and results of research on crash factors and rider protection. The state-of-the-art of preventive counter-measures is reviewed, in particular those presently used or planned. Conclusions and recommendations stress the need for more detailed information on accident statistics with an international comparison; there is a need for improved instruction and a graded licensing for two-wheel riders, with a maximum age limit, and for safety campaigns directed at other road users, especially car drivers. Increased police enforcement of control of alcohol intake by two-wheel riders is urged. Technical improvements in vehicles, compulsory inspection, and use of crash helmets are recommended. Town planning and traffic engineering have a major

effect on safety. A list of OECD Road Res. Group publications is appended.

by P. C. Noordzij, ed.
Organisation for Economic Co-operation and Devel., Road Res. Group on Prevention of Accidents to Users of Two-Wheeled Vehicles, 2, rue Andre-Pascal, 75775 Paris Cedex 16, France
1978; 129p 170refs
Availability: OECD Publications Center, Suite 1207, 1750 Pennsylvania Ave., N.W., Washington, D.C. 20006 \$7.00

HS-025 125

FIGHTING ROLLING RESISTANCE IN TIRES

The rolling resistance of tires can consume 20-50% of the energy used by a vehicle, depending on driving cycle, condition of the vehicle, and road surface. Tire and auto manufacturers are striving to find new ways of reducing these losses. If the rolling resistance on a typical passenger car could be reduced by 10%, gas mileage would improve by about 3%. Tire rolling resistance is caused by three factors: aerodynamic drag (1-5%), road friction (9-10%), and internal friction or hysteresis (85-95%). Hysteretic loss, caused chiefly by the flexing of the tire material as the vehicle moves, offers the best approach for tire designers to reduce rolling resistance. To better understand and solve the problem of rolling resistance, researchers have identified eight factors that influence energy loss due to road friction and hysteresis; these are tread depth, torque, slip angle, speed, time to reach equilibrium, cord configuration, load, and inflation pressure. Cord material and configuration determine, to a large degree, how much the tire material will flex and, consequently, how much hysteretic heating will occur. Possibly the most important factor influencing rolling resistance is tire pressure. The most obvious result of tire and vehicle manufacturers' programs to reduce the penalties of rolling resistance has been the extensive use of radial-ply tires, whose cord design wastes less energy than does a bias-ply design. The trend toward higher tire pressure is also a direct result of the battle against rolling resistance, and higher pressure in turn has led to elliptic tire design. Tire makers are looking at new tire compounds and cord materials. The Federal government is working to establish formal test methods for determining a tire's rolling resistance. More attention will also be focused on road deflection, another significant cause of rolling resistance which until recently has been ignored almost entirely in the U.S. A tire-test rig at Calspan's Tire Res. Facility in Buffalo is illustrated. The rig is computer controlled to duplicate 14 driving variables, including rolling-resistance moment, overturning moment, center-of-tire contact, lateral force, torque, road plane, wheel travel, slip angle, longitudinal force, wheel plane, inclination angle, and aligning torque.

Publ: Machine Design v51 n1 p30-1, 33-4 (11 Jan 1979)
1979
Based on material supplied by Calspan Corp., Tire Res. Facility.
Availability: See publication

HS-025 126

SPUTTERING COMES OUT OF THE CLEAN ROOM [COATING PROCESS]

Sputtering is a coating process that deposits thin films, usually of metal, on parts in a plasma environment. Ionized gas

molecules in the plasma bombard a metal or other coating material to break away atoms which then deposit as a coating on the part surface. Until recently, maximum thickness of sputtered coatings was limited to 0.1 micron or less, and the process was a slow, labor-intensive technique requiring skilled operators and a clean-room environment; the process had not been used on a large scale except to produce integrated-circuit components. Sputtering is now performing production-line jobs such as chrome "plating" of plastic automobile grilles, an application possible because of improvements in equipment and controls. Benefits include lower costs: sputtering lines are less expensive to set up and operate than plating systems; less coating material is required to produce an acceptable finish on parts. The process also provides less energy consumption, and virtual elimination of pollutants. Since the sputtering process is not regulated by classical thermodynamics, virtually any material can be sputter-deposited on any substrate. Sputtering parameters can be precisely controlled to produce required mechanical, chemical, and metallurgical properties in the coating. Another important feature is the capability to deposit coatings with graded compositions, laminated layers, and dispersion-strengthening effects; such gradients eliminate or reduce internal stresses that often develop when parts are heated or placed under load. The strong adherence of sputtered coatings can be attributed to the surface cleanliness and relatively high arrival energies of the sputtered material. Much of the sputtering research at the National Aeronautical and Space Administration is aimed at producing solid-film lubricants. Sputtering has been used for coating tool tips, cutting edges, and braking surfaces of brake drums with hard carbides or nitrides to improve wear resistance, and in other applications to prevent corrosion, oxidation, erosion and abrasion in severe environments.

by David T. Curry
Publ: Machine Design v51 n1 p95-9 (11 Jan 1979)
1979
Availability: See publication

HS-025 127

ELECTRONIC IGNITION TUNEUP

Step-by-step procedures are described for tuning up vehicles with electronic ignitions, pointing out the differences among American Motors, Chrysler, General Motors, and Ford products. Compared to standard ignitions, the points and condenser have been replaced in the electronic ignitions by a non-mechanical triggering system. This sensor and trigger wheel, as it is known on pre-1978 AMC cars, or reluctor and pickup assembly on Chrysler, Ford, and GM cars, is found where the old contact set was. The primary voltage is routed through the control box rather than the distributor. The reluctor and pickup or sensor and trigger wheel activate a switching transistor on the control box, which in turn makes and breaks the primary circuit. There is no physical contact between the parts of the triggering system, only magnetic oscillations. The increased output of the electronic ignitions is needed to fire the leaner mixtures in late model, lower-compression, emission-controlled engines. The service specialist must keep in mind the higher output and the electronic components when working on electronic ignition cars. These systems can develop up to 47,000 volts in the secondary, which has a wearing effect on the secondary components, only partially offset by the use of new materials. When problems develop, such as increased resistance caused by worn spark-plug electrodes, the higher voltage supplied by the new systems can burn holes in

distributor caps and rotors. Descriptions are provided for the GM HEI (high energy ignition) ignition system, the Chrysler Corp. electronic ignition, the AMC BID (Breakerless Inductive Discharge) system (Prestolite), and the three variations of Ford electronic ignition systems: SSI (Solid State Ignition), Dura-Spark I, and Dura-Spark II.

by Ken Zino

Publ: Motor v151 n1 p42-4, 46-8, 50 (Jan 1979)
1979

At head of title: Motor Clinic Series.

Availability: See publication

HS-025 128

HOLLEY 2210-2245 [CARBURETORS, SERVICING]

Descriptions of the four basic metering systems of the 2210 and 2245 series of Holley carburetors are followed by procedures for servicing them. The 2210 and 2245 dual-venturi carburetors both use a vacuum-operated power-enrichment system. The 2210 uses a single- or a dual-stage power valve for power enrichment, depending on car application. The 2210 is designed for 350- to 450-cu-in engines and is original equipment on Chrysler products. It is also used as replacement on 350-cu-in General Motors engines. The 2245 uses a gradient power-enrichment system which employs a one-piece, tapered power valve, and a closed-cell nitrophyl float material rather than a metal float. Despite these differences, general service procedures for both models are the same. The principal subassemblies include an air horn (or bowl cover) carburetor body and a throttle body. Both models include four basic metering systems which make servicing easier for the amateur. These systems include the idle system, which provides a reasonably rich mixture for both smooth idle, and a transfer system which operates at low speed; the main metering system which provides a leaner mixture for normal cruising; the power-enrichment system which is used to provide a richer mixture when high power output is desired; and the accelerator system, which is mechanically operated and provides the additional fuel needed during fast acceleration. The carburetor also includes a fuel inlet system that constantly supplies fuel to all the metering systems.

by John Samanich

Publ: Motor v151 n1 p67-70, 72 (Jan 1979)
1979

At head of title: Carburetor Series.

Availability: See publication

titative data on saccades, periods of eye/head compensation, and head movement. Independent variables include inter-display angle, display visibility, operator's knowledge of display location, and some relevant characteristics of a possible task which must be interrupted for the refixation. Inter- and intra-subject variability is also presented.

by Gordon H. Robinson

University of Wisconsin, Dept. of Industrial Engineering, 750
University Ave., Madison, Wis. 53706

ONR-N00014-75-C-0364

Rept. No. NR-197-028; TR-78-2; AD-A052 753; 1978; 33p
14refs

Availability: Corporate author

HS-025 130

ROAD SURFACE IRREGULARITY AND VEHICLE RIDE. PT. 1. VARIATION AND INTERPRETATION OF RIDE MEASUREMENTS

As part of a research program to quantify the relationships among road unevenness and riding comfort, the level of loading applied to the road structure, and vehicle handling and control, an investigation was made of the relationship between subjective assessment and an objective measure of ride. The objective measure of ride is defined as the root-mean-square of the vertical acceleration at the person/seat interface in a moving vehicle. An experiment is described designed to examine the repeatability of the objective measure of ride and the variability of its subjective assessments. Results show that the repeatability of the objective measure of ride is constant over the range of accelerations examined and unlikely to exceed 0.004g. This level of repeatability is considered acceptable for riding-comfort studies. The relationship between subjective assessments of ride and the objective measure of ride can be quantified in the form of a "comfort characteristic curve", which gives the probability that a given quality of ride will be rated as acceptable or better by vehicle occupants. The level of the objective measure of ride increases linearly with speed; this level depends on vehicle type and on the unevenness of the road profile.

by D. R. C. Cooper; P. G. Jordan; J. C. Young

Transport and Road Res. Lab., Construction and Maintenance
Div., Crowthorne, Berks., England

Rept. No. TRRL-SR-341; 1978; 28p 5refs

Availability: Corporate author

HS-025 131

ROAD SURFACE IRREGULARITY AND VEHICLE RIDE. PT. 2. RIDING COMFORT IN CARS DRIVEN BY THE PUBLIC

A study was made of the subjective response to riding comfort of a sample of over 600 car drivers, driving their own cars over road surfaces of various types of construction, with varying standards of surface regularity. Subjective impressions of riding comfort were related in quantitative terms to an objective measure of ride represented by the root-mean-square (rms) vertical acceleration experienced at the person/seat interface. The relationship established, in the form of a "comfort characteristic" curve, shows that, for a ride with an rms acceleration of less than 40×10 to the minus 3g, 95% or more of the subjects rated the standard of ride as being acceptable or better. For rms accelerations greater than 40×10 to the minus

HS-025 129

DYNAMICS OF THE EYE AND HEAD DURING MOVEMENT BETWEEN DISPLAYS: A QUALITATIVE AND QUANTITATIVE GUIDE FOR DESIGNERS

The dynamics of the eye and head are described as vision is redirected from one fixation point to another, with the purpose of providing a designer or systems analyst with a guide to human performance limitations in vision. Common tasks include monitoring large instrument panels and controlling complex vehicles, particularly the visual dynamics involved when driving an automobile and merging from an on-ramp onto a busy freeway. The focus is on large angular separation (greater than 20 degrees) and on tasks wherein speed is important. Patterns of eye and head movements are shown, as well as quan-

g, this proportion decreases almost linearly with increasing rms acceleration. The relationship between comfort rating and rms vertical acceleration could form the basis of a proposed revised specification for road surface regularity in terms of the standard of riding comfort afforded by the surface. Comparison of responses on rigid and flexible roads showed that, though similar acceleration levels were experienced, there was a greater probability, at the higher levels, that the assessment of ride on concrete surfaces would be less favorable. The levels of acceleration experienced by the drivers showed no significant difference from those measured at the rear-seat position; "comfort characteristic" curves for males and females showed no difference in subjective assessment of rides for the same levels of acceleration. Further investigation will examine the standards of riding comfort in public transport and heavy goods vehicles and investigate the causes of the differences found between flexible and rigid construction.

by D. R. C. Cooper; J. C. Young
Transport and Road Res. Lab., Construction and Maintenance
Div., Crowthorne, Berks., England
Rept. No. TRRL-SR-400; 1978; 31p 1ref
Availability: Corporate author

HS-025 132

THE WIND-AVERAGED DRAG COEFFICIENT APPLIED TO HEAVY GOODS VEHICLES

The wind-averaged drag coefficient provides a means of assessing the aerodynamic performance of a road vehicle in relation to the wind conditions encountered in service. Effectiveness of this method is discussed, together with details of a study of the various approximations which can be made in evaluation of the method. The largest source of error to be met during computation of wind-averaged drag coefficients is the choice of a national average wind speed; this includes defining a suitable standard height and correcting observed wind speeds to that height. A standard height of 3m is recommended. Appended is a description of a computer program currently in use for evaluating wind-averaged drag coefficients.

by K. C. Ingram
Transport and Road Res. Lab., Transport Engineering Div.,
Crowthorne, Berks., England
Rept. No. TRRL-SR-392; 1978; 25p 7refs
Availability: Corporate author

HS-025 133

EVALUATION OF THE PERFORMANCE OF PORTABLE PRECAST CONCRETE TRAFFIC BARRIERS

To obtain information on the effectiveness of a portable concrete traffic barrier in a construction zone environment, an evaluation was made during the widening of the Virginia Beach-Norfolk Expressway (Route 44). A review of the literature on the performance of the "safety shape" barriers revealed that the end of the barrier should never be exposed to oncoming traffic; the barrier joints must be tight for the barriers to act as a system; the longitudinal axis of the barriers should be placed parallel to the roadway, except when the barrier system is started with a flare; the barrier system should have a minimum length of 100 ft (30 m); and the barrier system must have lateral support in order to prevent vehicle

penetration. Examination of accident data before and during construction on Route 44, analysis of tire marks, and an examination of the effects of Route 44 construction on traffic characteristics, revealed that there was an average of 49 vehicle contacts with the barrier for every reported accident in which it was involved; there was a definite tendency for motorists to stay out of the barrier lane, but avoidance of that lane was reduced as volume increased; and with a 55 mph (88 km/h) posted speed limit, the vehicular speeds were reduced by only a few miles per hour when the barriers were in place. Evaluation of performance during the widening of I-95 is recommended, since that highway carries a much higher volume of tractor-trailers than does Route 44.

by Frank N. Lisle; Bradley T. Hargroves
Virginia Hwy. and Transportation Res. Council,
Charlottesville, Va.
Rept. No. VHRCTC-79-R29; 1978; 41p 12refs
Sponsored by Virginia Dept. of Highways and Transportation
and by Univ. of Virginia.
Availability: Corporate author

HS-025 134

WEIGHT PROPAGATION AND EQUIVALENT HORSEPOWER FOR ALTERNATE-ENGINED CARS

In order to evaluate properly the consequences of replacing conventional Otto-cycle engines with alternate power systems, comparisons must be carried out at the vehicle level with functionally equivalent cars. This paper presents the development and application of a procedure for establishing equivalent vehicles. Seven alternate heat-engine types were investigated: Uniform Charge (UC) Otto (baseline); alternate UC Otto; Stratified Charge Otto; Turbocharged Diesel; Single Shaft Brayton; Free Turbine Brayton; Stirling; and Rankine (steam). A systematic weight propagation methodology, based on detailed weight breakdowns and influence factors, yields the vehicle weight impacts due to changes in engine weight and power. Performance-matching criteria, utilizing a vehicle simulation program, are then employed to establish Otto-engine-equivalent vehicles, whose characteristics can form the basis for alternative engine evaluations.

by Gerhard J. Klose; Donald W. Kurtz
California Inst. of Tech., Jet Propulsion Lab.
Rept. No. SAE-780348; 1978; 14p 4refs
Technical Paper Series. Presented at Congress and Exposition,
Detroit, 27 Feb-3 Mar 1978. Research conducted for Energy
Res. and Devel. Administration, Dept. of Energy, by
agreement with National Aeronautics and Space
Administration.
Availability: SAE

HS-025 135

INCREASE IN FATALITIES REKINDLES CONTROVERSY [MOTORCYCLE HELMET USAGE LAWS]

The National Hwy. Traffic Safety Administration (NHTSA) concludes that the repeal of mandatory motorcycle helmet laws in 26 states was the major factor in the 23% increase (representing 4051 fatalities) in motorcycle fatalities in the U.S. in 1977, but the results of investigations by the American Motorcyclists Assoc.'s (AMA) Government Relations Dept. (GRD) contradict the government's claim. The GRD found that fatality increases in six states with high motorcycle regis-

tration were far above the national average, none of these states having repealed helmet laws prior to or during 1977. The GRD investigation also found that NHTSA apparently ignored the fact that in 18 of 26 repeal states, continued mandatory helmet use is required for young and/or inexperienced riders; that 17 states include mopeds in motorcycle statistics; that NHTSA deemphasized the importance of the speed limit factor (erosion of compliance with 55 mph limit) in the motorcycle fatality increase; that the Dept. of Transportation's Fatal Accident Reporting System (FARS) figures show no difference in the fatality rates (fatalities to registrations) of states which had helmet laws and states which had repealed laws; and that in 31% of the fatalities studied by FARS, the NHTSA was unable to determine whether or not the fatally-injured motorcyclist was wearing a helmet. The AMA isolated statistics on number of fatalities per 100 accidents, a more valid statistical means of measuring the effectiveness of helmets and helmet laws. These figures show no difference in the fatality rate for repeal and non-repeal states. Strong evidence was found by AMA that there was significantly more exposure of motorcyclists to traffic in 1977 than in previous years, a possible contributory factor in increased motorcycle fatalities. Because of unanswered questions and contradictory evidence, the AMA refuses to accept NHTSA's conclusion that repeal of helmet laws was responsible for the increased fatalities in 1977.

Publ: American Motorcyclist v32 n11 p22, 41 (Nov 1978)
1978; 1ref
Availability: See publication

HS-025 136

TECHNIQUE FOR CONTINUOUS RECORDING OF VEHICLE HEADWAY

A technique for the continuous monitoring and recording of time headway, using an application of the coincidence method of measuring distance, was developed for application in a portable closed-circuit television system. The system provides in each recorded video frame the necessary information to determine distance of the lead vehicle and instantaneous time headway in any following episode. Provision is also made for recording vehicle braking and time on task. The system has been used successfully over a period of four months incorporating 600 hours of observation in over 14,000 mi of driving. It provides a continuous and unambiguous record of the driver's performance in relation to vehicles ahead in both day and night driving. Since it does not require the use of observers either on the road or in the driving cab, the setting for the driver is naturalistic. The system is unobtrusive in the sense that the driver need not know which component of his driving performance is under study.

by Raymond G. C. Fuller; Nicholas J. McDonald; Patrick A. Holahan; Edward P. Bolger
DAERO-76-G-042
Publ: Perceptual and Motor Skills v47 n2 p515-21 (Oct 1978)
1978; 12refs
Availability: See publication

HS-025 137

THE PROBLEM OF FRONTAL CRASH TESTS (BEITRAG ZUR PROBLEMATIK DES FRONTAL-CRASH-TESTS)

Various automotive safety engineering studies conducted by European researchers are cited in a discussion of the arguments for and against the use of 0 degree and 30 degree angle frontal crashes, in vehicle/barrier crash testing of automobile front-end structures. Each of the two types of frontal crashes is equally simple to simulate. The question is which angle comprises the significant majority of actual traffic accidents where the design of the front structure is critical to the integrity of the passenger compartment and thus to the protection of vehicle occupants. There is also the question of what type of crash testing produces the best design of the front end for real world crash protection. Priority has currently been given to the 0 degree crash; this is the standard established for motor vehicle testing in the U.S. According to the latest European findings, particularly in French research, the crash into a fixed object at 30 degrees better represents a large number of actual frontal accidents. It is felt that preference should be given to this type of crash in the design of front-end structures.

by Joachim Fischer
Publ: ATZ Automobiltechnische Zeitschrift v80 n9 p407-10,
413 (Sep 1978)
1978; 19p 9refs
Translated from German (original 5p; translation 14p).
Availability: Reference copy only

HS-025 138

HOW ABOUT SOMETHING A BIT SMALLER? [SMALLER U.S. CARS TO MEET FUEL ECONOMY STANDARDS]

To curb the use of energy, the car fleets produced by each U.S. automaker must deliver, on average, at least 18 mpg in the 1978 model year and 19 mpg in 1979; these averages must rise in steps to 27.5 mpg in the 1985 model year. For each one-tenth of a mile below or above the standard, a \$5 charge or credit is set by the government against every car sold. For the 1978 model year, General Motors, Ford, American Motors, and Chrysler beat the target, GM easily, Ford less so. For the 1979 model year, the automakers are having a more difficult time. Ford is having particular trouble because of lagging sales of its smaller, more fuel-efficient vehicles. Because of the large credits picked up in the 1978 model year, it is unlikely that any car company will end up owing the government money in 1979. Since these credits can be used only in the year following the one in which they were earned, as early as the 1981 model year, when the Corporate Average Fuel Economy (CAFE) standard rises to 22 mpg, automakers with few, or no, credits to bring forward may possibly face stiff penalties. The situation is aggravated by Congressional action which raises the weight of trucks regulated from 6000 to 8500 lbs, and mandates a 2 mpg increase in each model year. This action threatens the lucrative van and light truck market. The auto manufacturers are demanding open Congressional hearings on the gas mileage regulations, with a downward revision from 2 to 1.5 mpg.

by Paul Gibson
Publ: Forbes v123 n2 p80-1 (22 Jan 1979)
1979
Availability: See publication

HS-025 139

**WISCONSIN BICYCLE DRIVER TRAINING COURSE
(INSTRUCTOR'S HANDBOOK)**

This voluntary Bicycle Driver Training Course is designed to give the bicycle driver basic information regarding laws, safe bicycling habits and proper driving techniques in traffic. It is divided into eight one-hour sessions covering history of bicycles, rules of the road, types of bicycles, selection of bicycles and equipment, operation skills, hazard identification and avoidance procedures, maintenance, bikeways, first aid and on-road driving. The instructor's handbook includes course objectives and organization, instruction, material/text with instructor hints, student workbook answers, and instructor guidelines. Appendices include a dictionary of cycling terms and extensive lists of books, pamphlets, periodicals, manuals and films pertaining to bicycling.

by Ronald L. Thompson
Governor's Office of Highway Safety, 131 W. Wilson St.,
Suite 803, Madison, Wis. 53702
1978; 93p
Availability: Corporate author

HS-025 140

**BICYCLE SAFETY SCHOOL FOR VIOLATORS. A
SUPPLEMENT TO THE MODEL PROGRAMS IN
PEDESTRIAN AND BICYCLE SAFETY FOR
WISCONSIN COMMUNITIES**

A course outline, discussion group guidelines (decision-making questions, role playing, devil's advocate, open-ended questions, bibliography), a multiple-choice and true/false bicycle driver test (with answers), a list of suggested films, and bicycle "rules to live by" are provided for the sponsors/instructors of a bicycle safety school for violators. The purpose of the school is to provide a means of counseling to an adult or youth offender who has been issued a bicycle violation notice or citation. The school curriculum is designed to give every bicyclist attending the school a better knowledge and understanding of motor vehicle laws relating to bicycle operation, to evaluate his driving habits through group discussion and/or instructor conference, and to enable the offender to become a safer bicycle driver as a result of attendance. Methods of instruction would include lecture, group discussion, audio/visual materials, and individual counseling divided into 1 1/2 hr to 2 hr periods. Sponsors would be police/sheriff departments or a regularly-established safety organization. Instructors may be law enforcement personnel, or preferably neutral instructors from a safety organization, or driver education instructors trained in decision-making methods. It is recommended that classes be no larger than 30, with 15-20 students being ideal.

by Ronald L. Thompson
Governor's Office of Hwy. Safety, Suite 803, James Wilson
Plaza, 131 W. Wilson St., Madison, Wis. 53702
1978; 10p 14refs
Availability: Corporate author

HS-025 141

**THE MOVING BASELINE OF CONVENTIONAL
ENGINE-POWERED PASSENGER CARS (1975-1985)**

A review and assessment of engine, transmission, and vehicle design trends and Environmental Protection Agency (EPA) fuel economy and emissions data for 1973-1978 indicate that by 1985 the size and weight of new vehicles in the four passenger car classes - small, compact, mid-size, and full-size - will be considerably reduced from most of those of today and that the fuel economy of the downsized vehicles using gasoline and diesel engines will be close to or will exceed the 27.5-mpg (composite cycle) standard for 1985. The engines required by the projected 1985 vehicles would be compact, light, and of relatively low horsepower (HP) - less than 100 HP except for full-size vehicles, which would require 110-125 HP. Recent developments such as increasing engine revolutions per minute, material substitution to reduce weight, and turbocharging, have significantly changed the baseline of the conventional engines and resulted in engines quite compatible with the downsized vehicle designs. In the areas of fuel economy and emissions, there have also been significant improvements in the current (1978) and projected (1985) capability of the conventional engines. Composite fuel economies of 54, 43, 34, and 26 mpg using gasoline engines, and 60, 47, 38, and 32 mpg using diesel engines have been projected for small, compact, mid-size, and full-size cars in 1985, respectively. Those fuel economies are about 20% greater than those being achieved (EPA certification data) in 1978 by four-speed manual-transmission-equipped vehicles of the same inertia weight and engine displacement. With the development of the three-way catalyst, it appears that nitrogen oxides (NOx) emissions of less than 1.0 g/mi (1.0, 0.8, 0.6, 0.4 g/mi for full-, mid-, compact-, and small-size cars, respectively) can be achieved using turbocharged gasoline engines. Whether these same low NOx emissions can be met using turbocharged diesel engines is unclear at the present time (1978), but initial results with small diesel engines offer some encouragement.

by Andrew F. Burke
California Inst. of Tech., Jet Propulsion Lab.
Rept. No. SAE-780347; 1978; 24p 15refs
Technical Paper Series. Presented at Congress and Exposition,
Detroit, 27 Feb-3 Mar 1978. Research conducted for Dept. of
Energy, Div. of Transportation Energy Conservation, by
agreement with National Aeronautics and Space
Administration.
Availability: SAE

HS-025 142

**MOTOR VEHICLE ACCIDENT RECONSTRUCTION
AND CAUSE ANALYSIS**

For the use of lawyers, claims adjusters, highway safety engineers, and investigating officers, a description of physical factors of motor vehicle accidents is presented, such as the functioning of various vehicle components and their safety-critical contribution, as well as a mathematical description of different aspects of accident reconstruction. Among the topics covered are vehicle factors, which include the functions and design concepts of all essential vehicle components: chassis, frame and body, suspension, wheel tires and rims, steering and braking systems, engine, clutch, transmission, drive shaft, final drive, differential, drive axle, and electrical system. Vehicle motion analysis covers fundamentals of motion and force analysis, tire force, constant speed and acceleration analysis,

vehicle braking analysis, vehicle vibrations, and directional control. Accident avoidance analysis includes concepts of accident avoidance, alcohol effects on human response time, prediction of accident avoidance capacity, passing maneuvers, and driver view field analysis. Collision analysis covers impact and post crash motion analysis, collision analysis by computer, occupant dynamics, and human tolerance to impact loading. Government highway safety standards are outlined, including standards for crash avoidance, for injury reduction, and flammability standards, highway safety program standards, motor vehicle defects investigations, and motor carrier safety regulations. Accident investigation is described, including preparation and on-scene investigation. Accident reconstruction procedures are given for various types of accidents (i.e. single-vehicle, two-vehicle, turning, intersection, multiple vehicle). Special topics covered include the Multidisciplinary Accident Investigation (MDIA) program, special accident studies, and expert witness testimony.

by Rudolph Limpert

1978; 43p 48refs

Availability: The Michie Co., Charlottesville, Va.

HS-025 143

1978 FEDERALLY COORDINATED PROGRAM OF HIGHWAY RESEARCH AND DEVELOPMENT

The Federally Coordinated Program (FCP) project accomplishments are described for 1978. Highway safety research focuses on highway design, traffic engineering, accident investigations, and the special problems of selected highway conditions and users. Traffic operations research concentrates on optimizing traffic flow on freeways, developing traffic management plans and motorist information systems, and applying advanced technology to various types of roadways. Environmental research addresses water and air quality, noise abatement, general ecological problems, and socioeconomic factors. Materials research focuses on improving materials performance of bridge structures, embankments, and pavements, and on corrosion control. Structural research is directed at supplying structural design criteria for extending the service life of tunnels, highways, and bridges, and for improving their capability to withstand natural hazards of earthquake, wind, and flood. Highway maintenance research is aimed at optimizing maintenance activities through value engineering, equipment development and application, and management and administration. The Federal Hwy. Administration organization is diagrammed, and research and development branches are described. FCP categories and projects are listed.

Federal Hwy. Administration, Offices of Res. and Devel., Washington, D.C. 20590
1979; 31p 1ref

Availability: Corporate author

HS-025 144

CORROSION CAN AFFECT FUEL SYSTEMS

Tank materials, changing fuel chemistries, and various internal and external considerations are discussed as they affect future fuel tank designs and their ability to withstand underbody environments. Other concerns include trapped water, fuel compositions and their joint effects on system integrity. Terne plate, a lead-tin coated carbon steel which exhibits good fabricability and overall corrosion resistance, is used in most

domestic welded gas tanks. Trapped water can cause pinholing corrosion, which may be minimized by electroplating (electroterne). Electroplated zinc coated carbon steel is used by foreign producers, due to lower cost, coating uniformity, and avoidance of lead health hazard in manufacturing terne plate. One drawback is lower resistance weld line speed. With increasing exposure, some tank inner surfaces show white zinc corrosion products and subsequent base metal corrosion. Zinc carbonate also accumulates on fuel filter inner surfaces. Aluminum has been used in fuel tanks for aircraft and heavy duty trucks. Where aluminum has been used successfully, drainable sumps are provided for discarding condensed or trapped water and other corroding compounds. Organic fuel-resistant coatings are being studied (modified vinyl and polyethylene), as are lock seam and electron beam welding. Aluminum tanks appear to be 2-3 years from production. High density polyethylene fuel tanks are used in bulldozers, tractors, lawn mowers, snowmobiles, motorcycles, trucks, and foreign passenger cars, as well as in U.S. Army tanks and fighter aircraft. Advantages of plastic fuel tanks include elimination of corrosion, design flexibility, reduction in weight, and provision of an impact resistant vessel. Hydrocarbons can permeate plastic tank walls, causing pollution and tank swelling. Techniques for overcoming tank permeation include Sulfonation, fluorination, application of Barafene epoxy resin, and use of a nylon lining. Interior corrosion occurs due to accumulation of water and metal halides, especially at points of high localized surface strain. Remedial measures include tooling modifications, reorientation, formulation of non-corrosive gasoline ("dry gas") and anticorrosion additives. External corrosion occurs when moisture, dirt, and salt accumulate. Zinc chromate, petroleum base coatings, or a polyethylene foam barrier can be used to prevent accumulation of corrosive road debris. Sealed connections and relocation are recommended to prevent corrosion of electrical connections and wiring (fuel tank sensor units). Use of materials with higher temperature capability are also possible. Corrosion protection for fuel lines includes a sacrificial zinc coated wire wrapping, a neoprene jacket, and rerouting to avoid battery trays. For minimizing water contamination within the fuel system and corrosion of metal fuel tank linings, alcohols and/or aromatic compounds can be added to the fuel. Use of fuels containing high concentrations of methanol and ethanol require special measures for corrosion resistance, which are listed.

Publ: Automotive Engineering v87 n1 p42-5 (Jan 1979)
1979

Based on SAE-780920, "Corrosion Considerations in Design of Automotive Fuel Systems," by D. J. Bologna and H. T. Page.
Availability: See publication

HS-025 145

FROM RACETRACK TO ROADWAY [TURBOCHARGED ENGINES FOR PORSCHE PRODUCTION CARS]

Porsche's turbocharged six-cylinder horizontally-opposed 911 engine is described (3.3L displacement; 220 kW or 300 hp for the European version 195 kW or 265 hp for the U.S. version). The 911 combines turbocharging with the Robert Bosch "K-Jetronic" fuel injection system, which is described and diagrammed. The U.S. version of the turbocharged 911 Porsche is equipped with two thermal reactors, secondary air injection, and exhaust gas recirculation, and is the first turbocharged production car to earn the Environmental Protection Agency emission certification. Limitations in engine response ("turbo

lag") have made application of turbocharging to small engines difficult. Experience with turbocharged engines has shown that they require roughly the same emission control measures as naturally aspirated engines, and that they have the advantage of less exhaust gas volume at idle and low load. Since the geometric compression ratio is lower in a turbocharged engine, hydrocarbon and nitrogen oxides emissions are reduced. There are three possibilities for positioning a catalytic converter on turbocharged engines: close to the engine, upstream of the turbine; downstream of the turbine, with wastegated exhaust gas running through it; and downstream, with wastegated exhaust gas bypassed directly into the muffler. As with naturally aspirated engines, turbocharged engine fuel economy is affected significantly by compression ratio. At high load, specific fuel consumption is superior in turbocharged engines; turbocharging can increase the specific performance of an engine by 25-35%, permitting reduced displacement for a given performance level with significant improvement in fuel economy at idle and low load. Economy can also be improved with reduced number of cylinders (reduced engine and vehicle weight). Separate notes outline Porsche's race engine experience and a brief history of turbocharging since Buchi received the first patent in 1905.

Publ: Automotive Engineering v87 n1 p46-51 (Jan 1979)
1979

Based on SAE-780718, "Turbocharging Engines for Racing and Passenger Cars," by Hans Mezger.

Availability: See publication

HS-025 146

ELECTROMAGNETIC COMPATIBILITY MUST BE ASSURED

Guidelines are presented for making sure that automotive electronic equipment is compatible with its electromagnetic environment. Primary objectives for a system test facility include the following specifications: have a lead time of one year or less; have a test volume of 1000 cu m; be state-of-the-art; offer safe and legal operation; be accurate within plus or minus 10 dB; have a frequency range of 10 MHz to 12.4 GHz; and accept test levels of 200 V/m. Secondary objectives for the facility include the following: be commercially available; offer weather immunity; be unhampered by schedule restrictions; be free of reflections and standing waves; provide road speed and load testing; include a reflective ground plane; offer minimum test time; and require minimum site area for the test performed. Mechanical descriptions are provided for the following system test facilities: shielded rooms (with long wire, with septum, and anechoic rooms--with and without leveling); TEM (Stark, or Crawford) cells (with absorber, with loaded, offset septum, mode-stirred); reverberant cavities (per Mil-Std-1377, mode-stirred, subterranean rooms with antennas or parallel plates); anechoic funnel chambers; open air; and electromagnetic environmental simulators (EMES). The two anechoic shielded rooms described here are capable of satisfying present and future requirements, including electromagnetic compatibility (EMC) dynamometer testing.

Publ: Automotive Engineering v87 n1 p53-9 (Jan 1979)
1979

Based on SAE-780855, "Electromagnetic Compatibility of Automotive Vehicles--An Analysis of Possible Assurance Methods," by John T. Auman, Joseph C. Kindermann, and James J. Laggan.

Availability: See publication

HS-025 147

LUBRICANT FILMS EVALUATED VIA CONDUCTIVITY

Studies at Toyota on a functioning engine relate pitting or wear scarring to differences in oil film conductivity. A small DC voltage was applied to sliding metallic surfaces to measure formation and breakdown of lubricant films. Measurements of variations in conductivity were recorded by cathode ray tube and pens. Preliminary experiments were carried out using a cross-pin lubricant tester, followed by measurements made between a cam and a lifter on an overhead valve engine. The studies were conducted on an electrically driven Toyota 5R engine under several operating conditions with three grades of oil. SAE 30 oil had decreased conductivity with engine operating time; SAE 10W-30 behaved similarly, and SAE 5W-30 showed conductivity for longer periods than the more viscous oils. Conductive duration increased with the SAE 10W-30 after three days, at which time pitting of the lifter surfaces was observed. A computer-aided data processing system was developed to obtain relations between cam angle and average electrical voltage across the lubricant film.

Publ: Automotive Engineering v87 n1 p60-4 (Jan 1979)
1979

Based on SAE-780930, "Electrical Observation of Lubricant Film Between a Cam and a Lifter of an OHV Engine," by Kiyoshi Ninomiya, Masuhiko Kawamura, and Kenji Fujita.

Availability: See publication

HS-025 148

ETHYLENE/ACRYLIC ELASTOMERS: SEALING APPLICATION CANDIDATES

Ethylene/acrylic elastomers (EAE's) offer attractive blends of thermal stability, oil and weather resistance, mechanical properties, and low temperature performance for automotive sealing applications, replacing more expensive high temperature silicone and fluorocarbon elastomers. Of compounds predating EAE's, nitrile rubber (NBR) compounds can be used from -54 degrees C to 149 degrees C, although prolonged exposure above 121 degrees C may produce hardening and embrittlement. Polyacrylates provide good hot air and oil resistance, and have acceptable properties up to 177 degrees C; they are brittle at low temperatures (-18 degrees C). Silicones are effective up to 135 degrees C, are only moderately oil resistant, and have therefore poor wear resistance. They are marginal high temperature materials. Fluorocarbons have the best balance of physical and chemical properties for high temperature sealing, but are extremely costly. EAE's provide effective sealing from -54 degrees C to 177 degrees C; they do not revert, and show excellent resistance to seal wear, with a good balance of physical and chemical properties. Mechanical properties include tensile and elongation strength, and resistance to compression set, corrosion, tear, ozone, and weathering. EAE's show satisfactory resistance to engine, transmission and power steering fluids, as well as some gear oils, and to water and engine coolants. These elastomers have excellent vibration damping characteristics. Like most other compounds, they are not recommended to seal gasoline, passenger car brake fluid, phosphate ester based hydraulic fluids, or for concentrated acids. EAE seals are recommended for applications where seals are exposed to extreme temperatures for prolonged periods or where temperatures fluctuate between extremes. Qualification tests indicate excellent wear resistance. EAE components can be molded on compression, transfer or injection.

tion equipment. EAE's may be considered for application to transmission front pump, clutch, and engine front crankshaft shields, and, in the future, to engine rear crankshaft, transmission extension and shifter shaft, power steering pump, and possibly the pinion seal. Possible non-seal applications include spark plug boots, hose for radiator transmission and power steering, body and engine mounts, and coated fabric diaphragms.

Publ: Automotive Engineering v87 n1 p66-70 (Jan 1979)
1979

Based on "Ethylene/Acrylic Elastomers, New Candidates for Sealing Applications," by John Carr and Arthur Ginn.

Availability: See publication

CYLINDER VARIABLES INFLUENCE FUEL CONSUMPTION AND EMISSIONS

The effect of bore-to-stroke ratio (B/S) on indicated specific fuel consumption (ISFC) and emissions of a gasoline-fueled, spark-ignited, single-cylinder engine was studied while holding compression ratio and bore diameter constant. As B/S was increased from 1.1 to 3.3, both ISFC and hydrocarbon (HC) emissions increased significantly. Increased cylinder heat loss and, to a lesser extent, increased combustion duration were the principal causes of the ISFC increase. Increased surface-to-volume ratio was the principal cause of increased HC emissions. Influence of combustion chamber modifications on these effects was investigated. The B/S of U.S. passenger cars varies between 0.79 and 1.52. The variable stroke engine (VSE), which modulates its output power without inlet charge throttling, is being reevaluated for its fuel economy benefits. In the VSE, stroke length is shortened to reduce engine displacement and power output. As a result, engine operation at light load occurs at much larger B/S than in throttled engines. Initial VSE screening experiments were conducted for wide-open-throttle operation with stroke length as the variable factor. Subsequent tests were conducted on disc, hemi, and wedge combustion chamber shapes, and variations in combustion duration were also generated by altering valve lift and swirl. ISFC under these test conditions ranged from 220-245 g/kW.h at 1.1 B/S and from 235-295 g/kW.h at 2.2 B/S. ISFC was found to correlate with computed cylinder heat loss, allowing for various other factors. For an 18% ISFC increase, the heat losses were found to be attributable 72% to cylinder heat loss, 16% to combustion duration, 6% to combustion efficiency, and less than 6% to blow-by. Combustion chamber surface-to-volume ratio (S/V) and engine speed were found to be significant in relating heat loss effects to engine design and operating parameters, with surface area being more significant than heat transfer coefficient. Combustion duration was found to increase with S/V at each engine speed. As S/V increased, ISFC also increased at each engine speed; as engine speed increased, ISFC decreased. Some reductions in ISFC are possible via shortening combustion duration by more compact chamber geometries by more centralized or dual ignition, or by increased mixture motion. Emissions are also affected: relative hydrocarbon EI decreased slightly, relative nitrous oxide EI decreased significantly, and relative carbon monoxide EI increased significantly as combustion duration increased.

Publ: Automotive Engineering v87 n1 p72-7 (Jan 1979)
1979

Based on SAE-780968, "Engine Combustion at Large Bore-to-Stroke Ratios," by Robert M. Siewert.

Availability: See publication

HOW DOES AMBIENT TEMPERATURE AFFECT ECONOMY AND EMISSIONS?

Since Canadian ambient temperatures range much below 20-30 degrees C of the Environmental Protection Agency range, a Canadian Combustion Res. Lab. study measured relationships between fuel economy/emissions and ambient temperature. Fuel consumption increased significantly as ambient temperatures decreased, with diesel, stratified charge, lean burn, and turbocharged knock-limited engines showing less degradation in fuel economy and emissions than conventionally carbureted, catalyst-equipped engines. The new automobiles were found to offer especially large benefits in weight-normalized fuel economy and emissions at low temperature ranges. The chassis dynamometer tests were conducted according to 1975 Federal test procedures under controlled cold-room conditions at 21 degrees C, 4 degrees C, -12 degrees C, and -23 degrees C. Each vehicle was allowed to soak for at least 12 hours at the test temperature. All cars were equipped with radial ply tires. During the tests, the spark ignition engines were fueled with a spring/fall test gasoline lubricated with 5W/30 motor oil; the diesels were fueled with Grade 2 diesel fuel and lubricated with 10W/30 motor oil. Cars were run-in for at least 8000 km in combined urban and highway driving. At 21 degrees C, all tested vehicles met hydrocarbon (HC) and carbon monoxide (CO) standards. At -12 degrees C, all technologies except the diesel were above the Canadian HC standard, and conventional and lean burn engines exceeded the Canadian CO standard. At -23 degrees C, the conventional catalyst-equipped cars showed very poor performance and the diesel emissions remained at one g HC; all the spark ignited vehicles were above the CO standards, while the diesel had no CO emissions. Nitrogen oxide (NOx) emissions of all the tested vehicles remained within the Canadian standard (3.1 g/mile). At decreasing temperature, the stratified charge engine yielded decreasing NOx, while the turbocharged knock-limited engine increased; other NOx emissions were independent of temperature. A turbocharged knock-limited engine was compared with a conventional catalyst-equipped engine in two similarly equipped Buick Regal V-6 automobiles. At summer temperatures the conventional engine had a 13.8% fuel economy advantage at 21 degrees C, the fuel consumptions were equal, and at low temperatures, the turbocharged car had increasing fuel economy with decreasing temperature.

Publ: Automotive Engineering v87 n1 p78-80 (Jan 1979)
1979

Based on SAE-780935, "The Effects of Technology on Automobile Fuel Economy under Canadian Conditions," by C. S. Hayden.

Availability: See publication

TEN YEARS ROAD SAFETY IN THE NETHERLANDS

Data are presented to aid in formulating a road safety policy, especially in deciding priorities. These data include the changes and trends of road traffic and of road safety in The Netherlands since 1964; the drop in road fatalities in 1974 and the total damage of road traffic accidents; and completeness and reliability of basic data. Final observations point out the need for more complete information and discuss the criteria for research data on road safety: completeness, detail, accuracy.

September 28, 1979

HS-025 154

cy, uniformity, availability and accessibility, promptness, and the cost/benefit ratio.

by J. van Minnen; A. Blokpoel; F. C. Flury
Institute for Road Safety Res. SWOV, P.O. Box 71, 2270 AB
Voorburg, Netherlands
Rept. No. SWOV-1978-1E; 1978; 88p 22refs
Availability: Corporate author

HS-025 152

MAJOR TRAFFIC ACCIDENTS, STATE OF HAWAII, 1977

Data covering major traffic accidents in Hawaii are presented in graphic and tabular form. Traffic accident statistics, traffic-related data (vehicle miles traveled, motor vehicles and drivers registered, and resident population), accidents by day of week and by month, distribution of accidents and fatal accidents by light condition, distribution of driver involvement by age group, driver registration and involvement in all and in fatal accidents, are presented for 1977. The 1977 figures include statistics on drinking drivers involved in accidents, vehicle registration and involvement in accidents, contributing circumstances, and directional analysis (pedestrian accidents, collision between two or more vehicles, and non-collision and other accidents). Persons killed and injured by age group, and pedestrian fatalities and injuries by actions and age group for 1977 are also tabulated. For the years 1968-1977, data cover the number of accidents, fatal accidents and non-fatal injury accidents; the number of persons killed and injured; traffic accident, fatality and non-fatal injury rates; and vehicle miles traveled, motor vehicles and drivers registered, and resident population. The number of drivers and type of motor vehicles involved in all and in fatal accidents, and persons killed by month of year are also tabulated for 1968-1977. Summary figures reveal that the number of major traffic accidents in Hawaii (ones in which property damage totaled at least \$300 or in which there were personal injuries) increased 8.9%, from 14,860 in 1976 to 16,188 in 1977. Friday and Saturday accounted for 35.2% of total accidents and 42.8% of fatal accidents; February had the fewest accidents and December the most. Approximately 58% of all accidents and 46% of the fatal accidents occurred during daylight. Of accidents involving collisions between two or more vehicles, 41% occurred at intersections; of fatal accidents, 16% were at intersections. Of pedestrian accidents 63% of all and 82% of fatal accidents occurring at intersections involved vehicles traveling straight ahead; at non-intersections the figure was 88%. The number of pedestrians killed increased 13%; the number of pedestrians injured decreased by 4%. The fatality rate for Hawaii has remained below 4.00 since 1972, the rate for 1977 of 3.37 being the third lowest in the state's history. The driver involvement index (% involved in accidents vs % registered) is highest in the 15-24 age group in all accidents and in the subgroup 17 and under for fatal accidents. The index is lowest for 55-64 age group for all accidents, and in the age group 45-54 and 55-74 in fatal accidents. Drinking driving involvement in all accidents was up 5%, but in fatal accidents it decreased 18%. Motorcycle and motorscooter involvement in all accidents increased 16.5%; bus involvement in all accidents decreased. In total accidents and fatal accidents, buses had the worst involvement index. Trucks had the best involvement index in all accidents, and in fatal accidents passenger cars had the best involvement index. In 1977, drinking and/or speeding were contributing cir-

cumstances in approximately 20% of the accidents and accounted for 41% of fatal accidents.

Hawaii Dept. of Transportation, Traffic engineering Section
1978; 41p
Prepared in cooperation with Motor Vehicle Safety Office.
Availability: Corporate author

HS-025 153

DRIVERS' STEERING BEHAVIOR DURING TRAFFIC EVENTS: A CASE OF PERCEPTUAL TROPISM?

Seventy-five drivers participated in test runs, driving a total of 1500 km. Mean value and one standard deviation of steering wheel angle were plotted for several traffic events from 10 sec before the event until 10 sec after. Two seconds before meeting an oncoming car, there was a 1 degree shift in steering wheel angle to the left, toward the oncoming car. The peak value was obtained at the instant when the oncoming car passed. The original steering wheel position was regained 2 sec after the meeting. The behavior was more pronounced on narrow roads than on wide roads, and it was unaffected by driving experience. The behavior is explained by the perceptual significance of the oncoming car and, in analogy with tropistic behavior noted in lower organisms, the phenomenon is called perceptual tropism. The findings introduce a new dimension to analyses of steering behavior. The obtained results suggest that there are interactions between visual and motor behavior.

by Martin Helander
Publ: Human Factors v20 n6 p681-90 (Dec 1978)
1978; 19refs
Availability: See publication

HS-025 154

A TWO-LEVEL MODEL OF DRIVER STEERING BEHAVIOR

A two-level model providing a quantitative description of driver steering behavior was devised to evaluate the performance of the driver-vehicle system and to establish design criteria for favorable vehicle dynamics. The steering task included the guidance level involving the perception of the instantaneous and future course of the forcing function provided by the forward view of the road, and the response to it in an anticipatory open-loop control mode, and the stabilization level whereby any occurring deviations from the forcing function are compensated for in a closed-loop control mode. The parameters of the mathematical model were identified on the basis of data measured in driving simulator experiments. The parameter estimates of both levels of the model show significant dependence on the experimental situation which can be characterized by variables such as vehicle speed and desired path curvature. Future applications of the model include the investigation of the effects on human steering behavior of such vehicle dynamic parameters as steering sensitivity, position of the center of gravity, and tire features.

by Edmund Donges
Publ: Human Factors v20 n6 p691-707 (Dec 1978)
1978; 18refs
Availability: See publication

HS-025 155

A FIELD STUDY OF THE EFFECTS OF DRIVERS' ADAPTATION TO AUTOMOBILE VELOCITY

A roadside survey of vehicle velocities was carried out by radar on a four lane, median divided highway with a 50 mph (80 km/h) legal speed limit. Northbound traffic on the highway had been previously exposed to expressway conditions with vehicle speeds in excess of 96 km/h, whereas southbound traffic had been previously exposed to an urban highway with speeds of about 64 km/h. Northbound traffic velocities exceeded those of southbound traffic by an average 6.9 km/h, which suggests that the northbound drivers were influenced by the period of travel at higher speed. An analysis of the data by vehicle category indicates that while large cars are driven significantly faster than small cars under all conditions, the magnitude of the velocity adaptation effect is greater for drivers of small cars. The results are consistent with the interpretation of a previous study (1977) which demonstrated that for small cars auditory information makes a relatively greater contribution to perception of velocity and judgment of speed than for large cars. Since it is noted in the present study that the effects of observed speed adaptation endured beyond the immediate exit ramps of the expressway, it is recommended that a system of periodic striping be applied to a large section of the road surface immediately following the expressway. Such a system has been shown to reduce travelled velocity by 80% and accidents by 30%.

by Michael L. Matthews

Publ: Human Factors v20 n6 p79-16 (Dec 1978)

1978; 7refs

Availability: See publication

HS-025 156

1988--THEN WHAT? ONE MANUFACTURER'S VIEW OF THE CAR IN 10 YEARS' TIME

At an international workshop, "Auto '88", Volkswagen presented the company's forecast for the 1988 motor vehicle. It is envisioned that the 1988 car will be powered by a piston engine with gasoline or diesel fuel, and that engine efficiency will provide today's performance from a smaller engine. The car will be 10% lighter and 30% less wind resistant, smaller, yet roomier; it will be quieter and will create less exhaust pollution. Electronics will be used more extensively, possibly as some form of road induced direction finder. Both cars and the manufacturing process will consume less fuel. The use of aluminum is expected to save much weight, but will fall short of all-aluminum bodies, since aluminum production uses more energy than steel, and aluminum is also an exhaustible commodity. High strength steel and plastics can also save weight. Better packaging of a small car will provide 12% more inside space and 18% more luggage room, accomplished by smaller engine size, smaller, more efficient radiators, space-saving suspension design, smaller fuel tanks, disposal of the spare tire, thinner, plastic moulded seat back rests, and reflector mirror systems allowing luggage to be stowed up to roof level. An encapsulated engine is designed to reduce noise, but may create cooling and maintenance problems. More widespread use of the turbocharger is envisioned, especially for the diesel engine, enabling it to achieve a 70 mpg fuel consumption. Electronic ignition will be accompanied by digital idling stabilizing (DLS) electronics, LCD electronic instrument display, a multiplex board network, electronic gearbox control, and an electronic atlas (Bosch ALI system). The future of the electric

car is not promising, until there is a breakthrough in batteries. In an energy crisis, synthetic fuels, alcohols, hydrogen, liquefied petroleum gas, and synthetic 'natural' gas are future possibilities. Better seat belts, particularly passive belts, are being developed. Volkswagen's prediction for the features of the 1988 car are summarized in a table, compared with the 1978 car.

by Ray Hutton

Publ: Autocar v149 n4286 p22-3 (30 Dec 1978)

1978

Availability: See publication

HS-025 157

EXOTIC NEW BATTERIES--MORE MILES FOR ELECTRIC CARS

High-performance batteries for electrical vehicle (EV) use are envisioned in the distant future. Performance criteria for the batteries include enabling EV's to run at normal highway speeds with a 200 mile range, to be rechargeable in a few minutes, and to last as long as an engine-powered car at the same initial and maintenance cost. These batteries should be contained in a light, tight, safe package. Five basic types of batteries may be candidates for future EV use: cells in aqueous electrolytes; ambient-temperature cells in non-aqueous electrolytes; fused-salt, elevated temperature systems; systems with ion-exchange or ion-conducting membranes; and fuel-cell systems. In order of increasing energy density, fuel-cell systems include lead/acid, nickel/iron, nickel/zinc, lithium/iron sulfide, sodium/sulfur, zinc/chlorine, and lithium/air or aluminum/air. Performance of batteries in vehicles is measured by specific energy (Whr/lb), specific power (watts/lb), weight per vehicle, cost per kilowatt-hour (cycle life), and recharging behavior. Advantages of lead/acid batteries include good specific power, low cost, and the backing of a well-developed manufacturing technology. Nickel/iron alkaline batteries, invented by Edison, accept 5000 cycles, have substantial weight advantage, work at ambient temperatures, and need no costly, heavy housings. The General Motors (GM) zinc/nickel oxide battery (nickel/zinc) operates at ambient temperatures using a 40% aqueous potassium hydroxide solution. Advantages of this battery lie in its light weight and small volume. Due to depositing of zinc metal sponge on the negative plate, cycle life is shortened. A Swedish invention of vertical vibration of the zinc plate is expected to triple the cycle life of this battery. Lithium/iron sulfide batteries operate under near-vacuum conditions at 700-840 degrees F, requiring a rigid insulating housing. GM's lithium/iron disulfide cells are constructed like a sandwich (bipolar construction). Lithium/air or aluminum/air fuel cells offer the promise of quick recharge and unlimited range for EV's. Other future batteries are based on the "intercalation" process (wedging ions into a crystalline structure of lithium/titanium disulfide). The more advanced battery concepts are described, their estimated specific power noted, and characteristics tabulated.

by E. F. Linsley

Publ: Popular Science v214 n2 p78-83, 158 (Feb 1979)

1979

Availability: See publication

HS-025 158

HUMAN FACTORS SOCIETY. PROCEEDINGS OF THE ANNUAL MEETING (21ST), SAN FRANCISCO, CALIFORNIA, OCTOBER 17-20 1977

Applications of human factors theory are presented in 125 papers covering computer applications to instructional technology, computer programming, and man-computer dialogue. Other topics include human information processing, human performance modeling, and verification and assessment of design criteria. The concept and development of an ergonomics data base is presented, as well as applied ergonomics of the real world. Visual and psychomotor performance, and equipment design are included, as are image processing for target acquisition, flight crew vision and aircraft crew performance measures, and applications in diagnostic and therapeutic clinical electrophysiology. The human factor aspects of consumer products are covered, as well as applications of SAINT (Systems Analysis of Integrated Networks of Tasks), display systems and evaluation, performance measurement techniques, task design, simulators, and environmental stress. Other topics include the future of human factors theory and research methodology, environmental design in the microenvironment, current training research activities and issues, communications, management planning (the effect of technology and legislation), special populations, and automobile safety.

by Alan S. Neal, ed.; Robert F. Palasek, ed.
Human Factors Society, Inc., P.O. Box 1369, Santa Monica, Calif. 90406
1977; 580p refs
Includes HS-025 159--HS-025 172, and HS-025 174.
Availability: Corporate author \$15 to members, \$20 to non-members

HS-025 159

EFFECTS OF VIBRATION ON HUMANS: PERFORMANCE DECREMENTS AND LIMITS

The standards for vibration in Military Standard MIL-STD-1472B, Human Engineering Design Criteria for Systems, Equipment, and Facilities, were compared to data from the literature and were found to be inadequate. Families of isodecrement performance curves for tracking performance with various combinations of acceleration and frequency were derived for vertical (z-axis) vibrations. A similar family of isodecrement performance curves was derived for percentage decreases in number-reading accuracy for vertical (z-axis) vibrations. These findings were used to make recommendations for changes to MIL-STD-1472B for predicting and identifying excessive work station environments. Comments on literature and recommendations for future research are included.

by S. J. Morrissey; A. C. Bittner, Jr.
Texas Tech Univ., Lubbock, Tex.
Publ: HS-025 158, "Human Factors Society. Proceedings of Annual Meeting (21st)," Santa Monica, Calif., 1977 p68-72
1977; 20refs
Meeting held in San Francisco, Calif., 17-20 Oct 1977.
Availability: In HS-025 158

HS-025 160

SEATING, CONSOLE AND WORKPLACE DESIGN: SEATED OPERATOR REACH PROFILES

Traditional methods for the characterization of reach envelopes have been based upon systems designed for static measurement of reach and have been frequently less accurate than is desirable for design recommendations. The development and validation of a methodology for dynamic measurement of reach envelopes is described, based upon a position-sensing potentiometric system. The characterization of reach envelopes for restrained and unrestrained male and female seated operators is also described. Anthropometric data of subject populations, example reach envelope contours and comparisons of data from the present study with previous reach envelope data are presented. It is recommended that future efforts in characterizing reach envelopes (either as large-sample validations of present data or surveys for other target-population applications) employ methods similar to those developed for the Ayoub Reach Facility (ARF) system, as this methodology allows rapid and accurate measurement of many reach points in a dynamic reach environment. Future efforts employing the ARF system are planned, including examination of alterations in reach envelopes as a result of seat supination and of the use of the Ayoub Reach Anthropometer as a high-accuracy tool for more traditional anthropometric surveys.

by J. Thomas Roth; Mohammed M. Ayoub; Charles G. Halcomb
Texas Tech Univ., Lubbock, Tex.
Publ: HS-025 158, "Human Factors Society. Proceedings of Annual Meeting (21st)," Santa Monica, Calif., 1977 p83-7
1977; 12refs
Meeting held in San Francisco, Calif., 17-20 Oct 1977.
Availability: In HS-025 158

HS-025 161

SEATING, CONSOLE, AND WORKPLACE DESIGN: INTEGRATION OF LITERATURE AND ACCOMMODATION MODEL

A procedure is described for determining the percentage excluded from a seat-console design, given the percentage excluded on individual dimensions. Seven critical anthropometric variables for seat-console design were identified. A "computerized accommodated percentage evaluation (CAPE)" model was used to determine the percentage excluded on the total design of a seat console as critical limits were imposed on each individual anthropometric dimension. Results of this paper are applicable to meeting Military Standard MIL-STD-1472B criteria for accommodating 90% of the potential user population.

by D. M. Dannhaus; A. C. Bittner, Jr.; M. M. Ayoub; C. G. Halcomb
Texas Tech Univ., Lubbock, Tex.
Publ: HS-025 158, "Human Factors Society. Proceedings of Annual Meeting (21st)," Santa Monica, Calif., 1977 p88-91
1977; 13refs
Meeting held in San Francisco, Calif., 17-20 Oct 1977.
Availability: In HS-025 158

BIORHYTHM - AN ACCIDENT PREVENTION AID?

Review of the literature concerning the relationship of biorhythm theory to human error accidents indicates there is much inconsistency. This study attempted to resolve some of the existing variability through careful selection and statistical analysis of a driver-error subject population. Fatalities involving 506 U.S. Naval off-duty personnel were examined. Birth dates were compared with accident dates to determine if the differences between observed and expected accident frequencies were significant. No chi-square values were found to be statistically significant at the .05 level. It was concluded that biorhythm is not a useful accident prevention aid. Inconsistency in human error research will continue to be reported until experiments more precisely define birth and accident times and combine this information with more rigidly designed research methodology.

by Michael W. Brownley; Curtis E. Sandler
Naval Safety Center, Naval Air Station, Norfolk, Va.
Publ: HS-025 158, "Human Factors Society. Proceedings of Annual Meeting (21st)," Santa Monica, Calif., 1977 p188-92 1977; 14refs
Meeting held in San Francisco, Calif., 17-20 Oct 1977.
Availability: In HS-025 158

HS-025 163

A METHODOLOGY FOR CONDUCTING HUMAN FACTORS EVALUATIONS OF VEHICLES IN OPERATIONAL FIELD TESTS

A standardized methodology was developed for use in conducting human factors evaluations of trucks and similar vehicles within the context of operational field tests. The methodology focuses on the assessment of users' (drivers') judgments of the vehicles being evaluated and allows for the differential weighting of individual human factors characteristics. The methodology is presented, including recommended statistical analysis procedures. The key to the methodology is the Human Factors Vehicular Evaluation Instrument which is an interview form containing 85 human factors characteristics relevant to vehicle design and operation. Data are presented from the initial utilization of the methodology in an operational field test. Data analysis revealed that driver preference for vehicles A and C over vehicle B was based on differences in the driver compartment, handling characteristics, and ride characteristics.

by John A. Hicks, 3rd.
Army Res. Inst. for the Behavioral and Social Sciences, Fort Hood Field Unit, Fort Hood, Tex.
Publ: HS-025 158, "Human Factors Society. Proceedings of Annual Meeting (21st)," Santa Monica, Calif., 1977 p211-5 1977; 1ref
Meeting held in San Francisco, Calif., 17-20 Oct 1977.
Availability: In HS-025 158

HS-025 164

MAXIMAL PEDAL FORCES EXERTABLE BY WEAK FEMALES

The maximum capability of weak females to actuate manual brake systems and power brake systems with power failure depends upon a number of variables. The following variables are

discussed and preliminary conclusions made on their quantitative effect: percentile of population to be covered, sex, age, force within a trial, repeated trials, left vs right foot, static vs moving vehicle, location of pedal to driver and seat, and preferred seat location. Using many assumptions and skimpy data, a 5% U.S. female, seated in a properly adjusted seat, for a panic stop will exert about 215 N in a moving, full-size U.S. vehicle with power brake failure.

by Stephan Konz
Kansas State Univ., Dept. of Industrial Engineering, Manhattan, Kans. 66506
Publ: HS-025 158, "Human Factors Society. Proceedings of Annual Meeting (21st)," Santa Monica, Calif., 1977 p216-20 1977; 28refs
Meeting held in San Francisco, Calif., 17-20 Oct 1977.
Availability: In HS-025 158

HS-025 165

AUDITORY AND BIOMECHANICAL PERFORMANCE REQUIREMENTS FOR MOTORCYCLE HELMETS

The effect of wearing a helmet on the sensing of information necessary for safe operation of a motorcycle is examined. A laboratory study was made of simulated motorcycle operation and the sensing of sirens and horns of motor vehicles at various distances for subjects wearing helmets and subjects without helmets as control. A second study, parallel to the laboratory study, was conducted in an outdoor setting. A motorcycle helmet with full face shield and one without the shield were compared with a control subject wearing no helmet. A warning siren and a motor vehicle horn were presented to the subjects from front, rear, left, and right. Both tests indicated that the helmet did significantly attenuate the signal, and that the emergency vehicle siren or horn would have to be dangerously close to the cyclist before the sound could be heard. The alleged problem of motorcycle helmets producing injuries to the cervical spine in certain types of impact situations was analyzed from a biomechanical standpoint. Some helmet designs were found to be capable of producing injury to the neck for certain crash configurations between the helmet and a solid object. Suggestions are presented for modification of helmet design to significantly reduce the injury potential of the helmet. One modification specifies that the helmet does not extend down to the back of the neck. In general, the impact forces should be distributed over as wide an area as possible.

by Jerry L. Purswell; Alan L. Dorris
University of Oklahoma, Norman, Okla.
Publ: HS-025 158, "Human Factors Society. Proceedings of Annual Meeting (21st)," Santa Monica, Calif., 1977 p226-30 1977; 6refs
Meeting held in San Francisco, Calif., 17-20 Oct 1977.
Availability: In HS-025 158

HS-025 166

ILLUMINATION LEVELS AND PERFORMANCE OF PRACTICAL VISUAL TASKS

In an effort to supply adequate lighting without wasting energy, two experiments investigated the relationship between illumination level and practical task performance. In the first experiment, male and female college students performed six tasks in random order under six illumination levels (1 to 500 decalux). The tasks were timed and perceived effort was mea-

sured on the Borg scale. In the second experiment, 20 males in the age ranges of 30, 40, 50, and 60 years performed four tasks which were measured for time, accuracy, and perceived effort (Borg scale) under six illuminations (1 to 320 decalux). Results indicated that task performance improved with illumination level and declined with age. The North American illumination standards were judged to be adequate, but not excessive. It is recommended that lighting design be focused on "task lighting" with lesser surrounding "general" lighting.

by Corwin A. Bennett; Anand Chitlangia; Abhay Pangrekar
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Manhattan, Kans.; Indian Chain Co., Calcutta, India; Tandy
Communication's Co., Fort Worth, Tex.
Publ: HS-025 158, "Human Factors Society. Proceedings of
Annual Meeting (21st)," Santa Monica, Calif., 1977 p322-5
1977; 9refs
Meeting held in San Francisco, Calif., 17-20 Oct 1977.
Availability: In HS-025 158

HS-025 167

INTERNATIONAL ROAD SIGNS: INTERPRETABILITY AND TRAINING TECHNIQUES

A study was conducted to examine the difficulties experienced by military drivers in passing the road sign section of their European driver's test. Drivers in a U.S. Army armor battalion were instructed on international road signs according to one of the following techniques: Sign Only, Sign Elaboration, or Standard Lecture instruction. In the Sign Only condition slides of the 128 road signs were presented individually for ten seconds each, during which time the name of the sign was pronounced twice. In the Sign Elaboration condition, in addition to the name of the slide, a mnemonic cue was presented to facilitate recognition of the sign. The Standard Lecture instruction consisted of a platform lecture supplemented with training aids. No statistically significant differences were obtained among conditions during either training or criterion testing. Error rates for individual signs varied from 0 to 86% during training, and from 0 to 32% during criterion testing. These data call into question the ready interpretability of some international road signs. The interpretability of individual signs appeared to be a joint function of both prior familiarity with the sign and the concreteness of the pictorial representation. It was concluded that an efficient instructional technique was lacking for teaching the meaning of international road signs.

by Douglas Griffith; Tomme R. Actkinson
Army Res. Inst. Field Unit, Fort Hood, Tex. 76544
Publ: HS-025 158, "Human Factors Society. Proceeding of
Annual Meeting (21st)," Santa Monica, Calif., 1977 p392-5
1977; 5refs
Meeting held in San Francisco, Calif., 17-20 Oct 1977.
Availability: In HS-025 158

HS-025 168

THE EFFECT OF ENVIRONMENTAL STRESSES ON HUMAN FATIGUE

The relative effects were evaluated of a moderate or suboptimal level of environmental heat and noise stress on human stress and fatigue by utilizing performance and nonperformance parameters. Twenty-five male undergraduate and graduate students served as subjects for this investigation. Each subject was isolated in a specially constructed environmental chamber, with heat and noise designated as the two in-

dependent variables. The effects of both variables on three dependent measures were evaluated during a nonstress condition and a stress condition. Two physiological variables, heart rate and heart rate variability, were used to assess arousal effects of heat and noise stress. Performance data were also collected in the form of reaction time to a visual display. Analyses of physiological and performance data revealed the following effects. Heart rate and heart rate variability responses were found to be significantly higher in the moderate stress condition than in the nonstress condition. A statistically significant deterioration in performance was observed in the reaction time task. An increase in reaction time occurred when subjects were exposed to the moderate stress condition. The experiment has implications for highway safety, since driver performance during sustained vehicle operation is shown to be negatively affected by moderate amounts of environmental heat and noise.

by Michael L. Romansky; Ralph W. Plummer; Edward S. Neumann
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NSF-ENG-7410011
Publ: HS-025 158, "Human Factors Society. Proceedings of
Annual Meeting (21st)," Santa Monica, Calif., 1977 p443-7
1977; 8refs
Meeting held in San Francisco, Calif., 17-20 Oct 1977.
Availability: In HS-025 158

HS-025 169

VIBRATION, PERFORMANCE, AND PERSONALITY

The present study was conducted using 16 subjects, two test sites and two levels of vibration to investigate the "Fatigue Decreased Proficiency Boundary" (FDPB) set by the International Organization for Standardization (ISO). The subjects were qualified physically fit for exposure to whole-body, z-axis vibration. The subject's seat was a rigid, tractor-type, unpadded seat mounted on a base plate which carried footrests and handgrips. The test sites, in the Aerospace Medical Res. Lab., Wright-Patterson AFB, were selected to accommodate all the vibration frequencies used in an entire series of studies conducted by the Univ. of Dayton Res. Inst. in conjunction with the National Inst. of Occupational Safety and Health. Performance, physiological, and subjective measurements were taken in five test sessions for each subject. The physiological measure was heart rate. The subjective measures were ratings of motion severity and task difficulty. The Inst. for Personality and Ability Testing Sixteen Personality Factor Questionnaire (IPAT 16 PF) was administered. It was concluded that vibration induced at the level of the ISO FDPB did not affect human performance. Motion severity and task difficulty were rated significantly higher under the 8 Hz condition than under the 0 Hz condition and were significantly correlated to each other. No differences emerged between the two different vibration sites. The introversion vs. extraversion scale was not significantly correlated to the motion severity nor to the task difficulty scale as hypothesized; the scale was significantly correlated with all the measures of heart rate. (The subjects who exhibited highest heart rates tended to score on the introversion end of the Factor Q1 scale.)

by Bonnie Hunt
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College Station, Tex. 77843
Publ: HS-025 158, "Human Factors Society. Proceedings of
Annual Meeting (21st)," Santa Monica, Calif., 1977 p448-52
1977; 7refs
Meeting held in San Francisco, Calif., 17-20 Oct 1977.
Availability: In HS-025 158

CURRENT AND FUTURE RESEARCH ACTIVITIES IN DRIVER TRAINING

Research programs involving high school driver education, motorcyclist safety education, problem driver retraining, elderly driver retraining, handicapped driver training, commercial vehicle driver training, and an energy efficient driver training program are summarized. Some of the pros and cons of driver education are presented and problems with establishing valid on-the-road driver performance tests are discussed. The primary approach of the National Hwy. Traffic Safety Administration (NHTSA) to the problem of driver performance tests is to establish intermediate performance measures which sample the driving task in various traffic densities. For high school driver education, NHTSA has developed the Safe Performance Curriculum, with objectives based on driving task analysis. This curriculum is now being field tested. Research is also aimed at modifying the drinking and driving behavior of youthful drivers, and at measuring the influence of the instructor on driver education program outcome. Research on problem driver retraining is focused on an accident avoidance skill training program. New education and licensing programs for motorcycle safety are being investigated, with field tests underway on a novice rider course. Future research efforts are outlined, to be implemented through such delivery systems as high schools, commercial carriers, the Federal government, and military organizations.

by Robert M. Nicholson; Michael F. Smith
National Hwy. Traffic Safety Administration, Office of Driver and Pedestrian Res., Washington, D.C. 20590
Publ: HS-025 158, "Human Factors Society. Proceedings of Annual Meeting (21st)," Santa Monica, Calif., 1977 p482-4 1977
Meeting held in San Francisco, Calif., 17-20 Oct 1977.
Availability: In HS-025 158

HS-025 171

IN SITU DRIVING PERFORMANCE AND THE ALCOHOL IMPAIRED DRIVER

Blood alcohol concentrations (BACs), interview data, and unobtrusive measures of driving performance were obtained on public highways at 42 rural sites. Special data acquisition and recording systems were developed to obtain analog records of speed and lateral position electronically. Interview results confirmed that young male motorists are an important population-at-risk, but older male and female liquor drinkers are also prevalent. A double standard exists regarding attitudes toward beer and liquor, especially among younger males. Driving performance measures indicated that drivers with .08-.149 BAC react with caution to unexpected situations, but are less able to come smoothly to a stop when directed to do so.

by David K. Damkot
University of Vermont, Dept. of Psychology, Burlington, Vt. 05401
Publ: HS-025 158, "Human Factors Society. Proceedings of Annual Meeting (21st)," Santa Monica, Calif., 1977 p548-52 1977; 5refs
Meeting held in San Francisco, Calif., 17-20 Oct 1977.
Availability: In HS-025 158

THE RELATIONSHIP BETWEEN DRIVER VISION AND ACCIDENT INVOLVEMENT

A battery of eight different driver-related vision tests was administered to a sample of 890 licensed drivers. The battery included tests for static acuity under normal illumination, low level illumination and glare conditions; dynamic visual acuity movement detection sensitivity, both in the central and peripheral fields; visual field in the horizontal axis; and visual search effectiveness. Regression analyses performed to determine the relationship between accident rate and performance on the tests in the vision test battery, yielded significant multiple correlations ranging from $R = 0.09$ to $R = 0.30$, depending upon the driver age-group and specific measure used for accident rate (daytime accident rate vs. nighttime accident rate). Different vision tests were found to be differentially predictive of accident rate for different age groups. In general, static acuity under low levels of illumination and dynamic visual acuity were most consistently related to accident rate. The potential use of such a battery as a flexible screening device is discussed. Recommendations for a larger scale validation study specify that regression equations be developed separately for the four different age groups in this study, as well as for the different light conditions. It is suggested that older, more cautious drivers may compensate better for poor vision than young, risk-taking drivers who are unaware of visual impairment.

by David Shinar; John W. Eberhard
Indiana Univ., Bloomington, Ind.; National Hwy. Traffic Safety Administration, Washington, D.C. 20590
DOT-HS-5-1275
Publ: HS-025 158, "Human Factors Society. Proceedings of Annual Meeting (21st)," Santa Monica, Calif., 1977 p553-7 1977; 4refs
Meeting held in San Francisco, Calif., 17-20 Oct 1977.
Availability: In HS-025 158

HS-025 174

EFFECTS OF FUNCTIONAL SEPARATION AND LOW LEVELS OF BLOOD ALCOHOL ON THE RESPONSE TO AUTOMOBILE REAR-SIGNAL INFORMATION

The experiment investigated the effects of functional separation of brake and turn signals, and of low levels of alcohol intoxication on a driver's ability to detect and interpret rear-signal information presented on a model automobile in a laboratory setting. Twelve experienced drivers performed the laboratory task for one-hour sessions on five successive days. Three independent variables were examined in a randomized-block, factorial design. These consisted of two levels of model type, one with brake and turn signals combined under the same lens, the other with brake and turn signals under separate lenses; four levels of blood alcohol, .00, .02, .05, and .08%; and six levels of stimulus complexity, representing six types of rear-signal information. Response variables consisted of response errors and the latencies between the onset of the stimulus and both the onset and the completion of the response. Results indicated that the response variables were not equally sensitive to the task and that performance was significantly affected by model type and stimulus complexity. Performance deteriorated with blood alcohol levels as low as .05% on the combined model and .08% on the model that separated brake and turn-signal lights. Results are discussed in

terms of the stimulus-identification/response-choice components of the task, and in terms of optimal coding methods for rear signals. It is concluded that separation of brake and turn signals is important in an optimal rear lighting system. Questions on color and location of other lights in the system remain to be answered.

by Dennis A. Attwood
Transport Canada, Road Safety Unit, Downsview, Ont., Canada
Publ: HS-025 158, "Human Factors Society. Proceedings of Annual Meeting (21st)," Santa Monica, Calif., 1977 p562-6 1977; 6refs
Meeting held in San Francisco, Calif., 17-20 Oct 1977.
Availability: In HS-025 158

HS-025 175

INTERCORRELATIONS OF ANTHROPOMETRIC MEASUREMENTS: A SOURCE BOOK FOR USA DATA. FINAL TECHNICAL REPORT

Correlation matrices based on data from U.S. Air Force anthropometric surveys of women (1968, 127 variables), flying personnel (1950, 128 variables; 1967, 190 variables), and basic trainees (1965, 161 variables); a U.S. Army survey of women searates (1946, 60 variables); the Health Examination Survey of civilian adults (1960-1962, 18 variables); and a survey of law enforcement officers (1974, 23 measurements) are presented for use by engineers who need them in solving design problems and for anthropologists and statisticians whose analyses and understanding of the interrelationships of body size data depend significantly on these coefficients. Sample sizes in these surveys ranged from almost 2000 upward. Definitions and basic univariate summary statistics are presented for all variables involved. Appendices contain a glossary of anatomical terms, tables for establishing confidence limits for the correlation coefficients presented here, computer programs used in preparing this report, and an index by name, anatomical type, and anthropometric technique.

by Edmund Churchill; Thomas Churchill; Paul Kitka
Webb Associates, Inc., P.O. Box 308, Yellow Springs, Ohio 45387; Univ. of Dayton Res. Inst., Dayton, Ohio 45469
F-33615-76-C-5007
Rept. No. AMRL-TR-77-2; AD-A058616; 1978; 305p 12refs
Rept. for Jul 1975-Oct 1976.
Availability: NTIS

HS-025 176

DESIGNING FOR AUTOMOTIVE CORROSION PREVENTION. PROCEEDINGS OF A CONFERENCE HELD IN TROY, MICHIGAN, NOVEMBER 8-10, 1978

Sixteen papers consider various aspects of corrosion prevention and effects of de-icing chemicals. They include information on winter maintenance practice and research in Ontario, selection and use of de-icing chemicals and abrasives in North America and overseas, chemistry of the automotive environment, development of the anti-corrosion code for motor vehicles in Canada, and automotive corrosion testing methods. Also considered are corrosion protection by coatings, organic and inorganic, and improvement of design and materials to prevent corrosion, including fuel, exhaust and electrical systems. Corrosion in integrated electronics is discussed; and final reviews are presented of the fundamental mechanisms of

automobile corrosion and of trends and issues in present-day salting practices.

Society of Automotive Engineers, Inc., 400 Commonwealth Dr., Warrendale, Pa. 15096
Rept. No. SAE-P-78; 1978; 137p refs
Includes HS-025 177--HS-025 192.
Availability: SAE

HS-025 177

WINTER MAINTENANCE PRACTICE AND RESEARCH IN ONTARIO

In Ontario, Canada, four levels of service are specified for winter maintenance of roads, ranging from bare pavement to snowpacked, depending on traffic volume. Methods used include plowing, sanding, and salting. A research program was undertaken in the fall of 1977 to determine if techniques could be developed to reduce the amount of salt used while maintaining the same level of service. Tests of four different salting rates indicated that one rate was not enough for efficient winter maintenance. A tentative salting formula was devised, based on the type of snow to be removed, its thickness, the temperature and weather conditions. Further investigation is planned in the use of salt pretreated with a calcium chloride solution. Also tested was a compound designed to keep bridge decks and hazardous sections of road free of ice during early winter: a blend of chemicals (primarily flake calcium chloride) incorporated into the asphaltic-concrete mix when the pavement is surfaced. It proved effective, although expensive and possibly detrimental to the road surface; further tests are planned. Comparisons were made between sanding and salting; the effectiveness of sand containing larger percentages of salt is to be studied, and a research program is underway to evaluate the effect of salt on the environment.

by H. J. Fromm
Ontario Ministry of Transportation and Communications, Res. and Devel. Div., Canada
Publ: HS-025 176 (SAE-P-78), "Designing for Automotive Corrosion Prevention," Warrendale, Pa., 1978 p1-4
Rept. No. SAE-780906; 1978; 7refs
Conference held in Troy, Mich., 8-10 Nov 1978.
Availability: In HS-025 176

HS-025 178

SELECTION AND USE OF DE-ICING CHEMICALS AND ABRASIVES IN NORTH AMERICA AND OVERSEAS

The state of the art on selection and use of de-icing chemicals (rock salt and calcium chloride) and abrasives is presented. The need for these methods is considered, and problems associated with them. Adverse effects include damage to vehicles, to animal life, water and health, to soil and vegetation, highway structures and pavements. Research is being conducted to reduce the use of de-icing chemicals, to develop new materials and procedures to melt snow and ice, and to develop vehicle traction aids. Adverse effects due to chemical use can

be minimized through the combined efforts of road and automobile engineers.

by J. Hode Keyser
Universite de Montreal, Ecole Polytechnique
Publ: HS-025 176 (SAE-P-78), "Designing for Automotive Corrosion Prevention," Warrendale, Pa., 1978 p5-12
Rept. No. SAE-780907; 1978; 44refs
Conference held in Troy, Mich., 8-10 Nov 1978.
Availability: In HS-025 176

HS-025 179

CHEMISTRY OF THE AUTOMOTIVE ENVIRONMENT

The interaction of our natural elements such as rain, snow and humidity with chemicals introduced to the environment provides a complex chemistry which is one of the most corrosive in North America. Beside the chloride ion encountered in coastal areas and areas where salts are used for de-icing and dust control purposes, atmospheric pollutants provide acid-producing chemicals for further corrosion. Since time of wetness is critical, factors affecting this parameter will affect the corrosivity. Use of calcium chloride on roads increases time of wetness due to its deliquescence; the same property exists for some corrosion products on steel and aluminum where corrosion may occur in atmospheres of lower relative humidity. Entrapment of moisture where poultice build-up occurs provides a stationary electrolyte and a crevice environment as well as an increased time of wetness. A series of tables includes data on precipitation, temperature and humidity variations in a number of cities, chemical properties of soils, composition of seawater and effect of distance from the ocean on the atmospheric corrosion of metals, precipitation chemistry for locations in the eastern U.S., chemical analysis of poultice deposits obtained from wheel well areas of automobiles, salt usage data for states where poultice deposits were obtained, and laboratory tests for simulation of automotive environments.

by Robert Baboian
Texas Instruments Inc., Electrochemical and Corrosion Lab., Attleboro, Mass. 02703
Publ: HS-025 176 (SAE-P-78), "Designing for Automotive Corrosion Prevention," Warrendale, Pa., 1978 p14-23
Rept. No. SAE-780908; 1978; 30refs
Conference held in Troy, Mich., 8-10 Nov 1978.
Availability: In HS-025 176

HS-025 180

DEVELOPMENT OF THE ANTI-CORROSION CODE FOR MOTOR VEHICLES

Problems are enumerated which led to the development of a national standard of corrosion resistance for vehicles, including unethical practices by the auto industry in making adjustments to owners, and inconsistency in the legal system. A federal-provincial Task Force was established, responsible for development of a national Code, of a companion guide for owner care, a program to implement the Code, and of a program to monitor industry compliance with the Code. Most of the major companies selling vehicles in Canada have responded positively to the Code, though a major effort has not been made to promote anti-corrosion measures in media advertising, probably because of unwillingness to admit that

such a problem exists. Annual analyses of data are planned to continue, with public reports when appropriate.

by Warren Allmand
Ministry of Consumer and Corporate Affairs, Canada.
Publ: HS-025 176 (SAE-P-78), "Designing for Automotive Corrosion Prevention," Warrendale, Pa., 1978 p24-6
1978
Luncheon address at conference held in Troy, Mich., 8-10 Nov 1978.
Availability: In HS-025 176

HS-025 181

AUTOMOTIVE CORROSION TESTING

The state-of-the-art of automotive corrosion testing is reviewed, with particular emphasis on testing related to the exterior environment. Automotive cooling systems, exhaust systems, and hydraulic and lubricating oil systems are at least partially closed corrosion environments well adapted to both laboratory simulation and field testing, but the more openly exposed components are poorly adapted to testing. Factors affecting both laboratory and field tests are discussed, and recommendations for the conduct of field tests are presented. Coated test coupons and cabinet tests are discussed, as well as the virtually universal detrimental effects of salt.

by J. D. Palmer
J. D. Palmer Associates Engineering Ltd., London, Ont., Canada N6B 1B7
Publ: HS-025 176 (SAE-P-78), "Designing for Automotive Corrosion Prevention," Warrendale, Pa., 1978 p27-31
Rept. No. SAE-780910; 1978; 10refs
Conference held in Troy, Mich., 8-10 Nov 1978.
Availability: In HS-025 176

HS-025 182

FUNDAMENTALS OF CORROSION PROTECTION BY ORGANIC COATINGS

An overview of the principal factors involved in the initiation and propagation of the corrosion of painted steel is presented. One of the major protective functions of the paint system is to act as a barrier to electrolyte; corrosion begins at sites where penetration of electrolyte has occurred. Loss of paint adhesion, caused in most cases by cathodically produced alkali, results in the spread of corrosion. Improved corrosion protection can be obtained by use of alkali-resistant paint binder resins. Corrosion inhibitive pigments can improve performance by slowing the overall corrosion rate; conversion coatings can slow the lateral spread of alkali attack.

by A. G. Smith; R. A. Dickie
Ford Motor Co., Engineering and Res. Staff, Dearborn, Mich. 48121
Publ: HS-025 176 (SAE-P-78), "Designing for Automotive Corrosion Prevention," Warrendale, Pa., 1978 p32-5
Rept. No. SAE-780913; 1978; 43refs
Conference held in Troy, Mich., 8-10 Nov 1978.
Availability: In HS-025 176

CORROSION PROTECTION

Typical automotive finishing practices are described with emphasis on paint system capabilities and limitations that affect painted part corrosion resistance. Preliminary phosphating (cleaning and pretreatment) priming operations (either spray, dip, flow-coat or electro-coat techniques), and topcoating operations are reviewed and their limitations discussed, with suggestions for suitable part design to overcome system deficiencies. Use of auxiliary finishes, such as zinc-rich primers and wax-based coatings, and of pre-coated steel has provided good corrosion resistance. The need is stressed for the part designer to work closely with the finishing engineer to permit proper coverage of all surfaces.

by William E. Tudor
General Motors Corp., Pontiac Motor Div.
Publ: HS-025 176 (SAE-P-78), "Designing for Automotive Corrosion Prevention," Warrendale, Pa., 1978 p36-42
Rept. No. SAE-780914; 1978; 2refs
Conference held in Troy, Mich., 8-10 Nov 1978.
Availability: In HS-025 176

HS-025 184

DESIGNING BODY PANELS FOR CORROSION PREVENTION

To aid in avoiding the corrosive elements of the environment, the designer of sheet metal body panels should consider principles which provide optimal drainage and access for the application of protective coatings. Major vehicle body components are considered individually or in closely related pairs such as door inner and outer panels. The general guidelines for preferred construction of drain holes, shingling, shielding and access for material application are outlined for each major component. Drawings and/or photographs illustrate individual components, such as hood, fender, door, quarter panel, wheelhouse assembly, deck lid assembly, rear door lock pillar, rocker panel, and floor pan. Factors such as stamping feasibility, packaging, installation of other parts, and styling features will require deviations from the principles presented, as well as ingenious solutions from designers and suppliers.

by Arthur W. Bryant
Ford Motor Co.
Publ: HS-025 176 (SAE-P-78), "Designing for Automotive Corrosion Prevention," Warrendale, Pa., 1978 p43-9
Rept. No. SAE-780916; 1978; 2refs
Conference held in Troy, Mich., 8-10 Nov 1978.
Availability: In HS-025 176

HS-025 185

CORROSION BEHAVIOR IN AUTOMOTIVE TRIM APPLICATIONS

The performance of stainless steels, stainless clad aluminum and anodized aluminum as automotive trim materials is analyzed. Improved stainless steel trim systems include the use of new surface finishing methods, the development of Type 434 stainless utilizing a molybdenum addition for improved corrosion resistance, and development of a stainless clad aluminum bi-metal trim system to minimize galvanic auto body corrosion. Field test programs were carried out in actual

body steel in over four years' exposure in field tests. Anodized aluminum also minimizes galvanic corrosion, but this material pits severely, shows white surface discoloration and etching, and is more susceptible to damage by stone impingement. Anodized aluminum trim can lead to paint blistering due to saponification of the coating in regions adjacent to the trim.

by L. S. Redmerski
Colt Industries, Crucible Res. Center, P.O. Box 88, Pittsburgh, Pa. 15230
Publ: HS-025 176 (SAE-P-78), "Designing for Automotive Corrosion Prevention," Warrendale, Pa., 1978 p50-5
Rept. No. SAE-780917; 1978; 14refs
Conference held in Troy, Mich., 8-10 Nov 1978.
Availability: In HS-025 176

HS-025 186

COOLING SYSTEM CORROSION IN RELATION TO DESIGN AND MATERIALS

Field experience is reviewed revealing corrosion failures relating to engine cooling system design and material causes, as well as coolant deficiencies. Basic corrosion mechanisms are described and related to specific component failures: direct chemical attack; electrochemical processes, either galvanic (when dissimilar metals are electrically coupled) or local-cell action between anodes and cathodes on the surface of one metal; and cavitation-erosion corrosion. Factors accelerating corrosion in the cooling system include galvanic couples, aeration, exhaust gas leakage, corrosion products, metal stresses, localized hot spots, high coolant operating temperature, poor quality water supplies and certain coolant flow characteristics. The role of ethylene glycol base inhibited coolants is discussed and the real world of consumer practices and service problems is described. Photographs and diagrams illustrate damage to various surfaces and the right and wrong way of positioning components.

by E. Beynon; N. R. Cooper; H. J. Hannigan
Union Carbide Corp., Home and Automotive Products Div., Tarrytown, N.Y.
Publ: HS-025 176 (SAE-P-78), "Designing for Automotive Corrosion Prevention," Warrendale, Pa., 1978 p56-64
Rept. No. SAE-780919; 1978; 17refs
Conference held in Troy, Mich., 8-10 Nov 1978.
Availability: In HS-025 176

HS-025 187

CORROSION CONSIDERATIONS IN DESIGN OF AUTOMOTIVE FUEL SYSTEMS

Metals, plastics, and rubber components are used effectively in the fuel system. Among the metals areterne (lead-tin coated carbon steel), zinc coated steel, and aluminum. Some of the material limitations are outlined and corrective measures described to minimize corrosion or materials degradation. For example, the use of zinc chromate coating, petroleum base coating, and/or polyurethane foam barriers may be required to minimize the effects of road de-icing salt and mud. Fuel tank electrical connections may require sealed connections and the use of water resistant grease. Zinc coated armor wire protection of the metal fuel lines and optimum material selection of

the rubber components of the fuel lines are also discussed. New legislative proposals to add increasing amounts of alcohols to gasoline may dictate further materials design optimizations as suggested by a review of some selected references dealing with this subject.

by D. J. Bologna; H. T. Page
Chrysler Corp., Detroit, Mich.
Publ: HS-025 176 (SAE-P-78), "Designing for Automotive Corrosion Prevention," Warrendale, Pa., 1978 p65-70
Rept. No. SAE-780920; 1978; 10refs
Conference held in Troy, Mich., 8-10 Nov 1978.
Availability: In HS-025 176

HS-025 188

MATERIALS, DESIGN AND CORROSION EFFECTS ON EXHAUST-SYSTEM LIFE

A description is given of contemporary exhaust-system metal-deteriorating conditions, and their relation to exhaust component failure mode and likelihood, based on materials and design considerations. Exhaust-component durability is discussed, and specific failure sites and metal corrosion-oxidation conditions identified. Localized, external corrosion is shown to be an important source of metal failure in exhaust-system components. Internal, muffler-condensate corrosion is likely to produce the most rapid rate of metal-thickness decrease, and component failure. The effect of the catalytic converter on internal corrosion is discussed. Exhaust-component steels' corrosion oxidation resistance depends both on the metallic coating, and the internal and external exhaust-system operating environment. Traditional steel usage in exhaust-systems may change, due to current and future requirements of reduced-weight and/or extended life.

by William R. Patterson
Walker Mfg. Co., Grass Lake, Mich.
Publ: HS-025 176 (SAE-P-178), "Designing for Automotive Corrosion Prevention," Warrendale, Pa., 1978 p71-106
Rept. No. SAE-780921; 1978; 24refs
Conference held in Troy, Mich., 8-10 Nov 1978.
Availability: In HS-025 176

HS-025 189

ELECTRICAL COMPONENT CORROSION PREVENTION

As an aid to the designer of automotive electrical components the various types of corrosion are enumerated, and preventive measures to be taken during the design stage are presented. Galvanic corrosion can be controlled by the use of zinc sacrificial coating, by reducing the area of cathodic metal, or by coating the surface with an organic material to seal out the electrolyte, by use of distilled water, and by designs that include drain holes, good air flow and lack of areas for moisture to collect. Protection from direct attack can be by use of a weathering steel containing small amounts of alloying elements to form a tight oxide layer on the surface, by coating the exposed surface with a metallic, organic or inorganic ceramic material more resistant to attack, and by removing attacking elements through air movement, drain holes, rounded edges, and sealing of the entire unit. To reduce fretting corrosion, the amount of relative motion at the interface should be reduced, the hardness of steel parts increased and lubricant added to the interface. Further information is given on stress corrosion, crevice corrosion, corrosion fatigue, intergranular corrosion,

hydrogen embrittlement, dezincification and grafitization (forms of selective leaching), caustic embrittlement, erosion and cavitation corrosion. Various coatings and sealers are considered: organic and inorganic coatings, paints, primers, varnish and resin systems, plastisols, silicone compounds, metallic coatings, oils and greases. Characteristics of current carrying materials are discussed: steel, brass, copper, phosphor-bronze, and beryllium copper. Types of plating are considered: zinc, cadmium, copper, nickel, tin-zinc, tin, silver and gold. A comparison is made of two types of sealing connectors: molded-on grommet, or connector with insertable design; advantages and disadvantages of each are listed.

by M. Michael Jones; Edward E. Welker
Delco Remy Div., Anderson, Ind.
Publ: HS-025 176 (SAE-P-78), "Designing for Automotive Corrosion Prevention," Warrendale, Pa., 1978 p107-18
Rept. No. SAE-780924; 1978; 8refs
Conference held in Troy, Mich., 8-10 Nov 1978.
Availability: In HS-025 176

HS-025 190

CORROSION IN INTEGRATED ELECTRONICS

A review of corrosion mechanisms in integrated electronics is presented. For metallization corrosion to occur, moisture and impurities such as Na, K or Cl (sodium, potassium or chlorine) must be present to form an electrolytic cell. The aluminum metallization of Integrated Circuits (IC) must be protected from the environment to prevent corrosion from occurring. Thick Film Hybrid circuits, besides being susceptible to IC corrosion mechanisms, can also fail due to dendrite formation causing shorting between gold or silver conductors that are exposed to moisture and halogen impurities. The lifetime of plastic parts in humid environments can be extended by using hermetic IC chips.

by Eugene Greenstein
Ford Motor Co., Electrical and Electronics Div.
Publ: HS-025 176 (SAE-P-78), "Designing for Automotive Corrosion Prevention," Warrendale, Pa., 1978 p119-22
Rept. No. SAE-780925; 1978; 7refs
Conference held in Troy, Mich., 8-10 Nov 1978.
Availability: In HS-025 176

HS-025 191

FUNDAMENTAL MECHANISMS OF AUTOMOBILE CORROSION

A brief review of the basic theory of the electrochemical corrosion of metals is presented, with emphasis on the mixed-potential theory. Currently accepted electrochemical corrosion mechanisms of several major forms of corrosion are reviewed: galvanic, crevice and pitting types. Present theories on the atmospheric corrosion of steel help to define more clearly the basic requirements for corrosion control: reducing the partial anodic and/or cathodic reaction rates, or isolating the metal from the corrosive environment (electrolyte). The use of inhibitors, or of sacrificial metallic coatings, or improved design can minimize the exposure of automotive surfaces to moisture. The development of improved paint systems, the use of nickel-chromium decorative/protective systems for exterior use, and the continuing development of alloys having passive

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oxide films are some of the possible measures to reduce corrosion.

by V. Hospadaruk
Ford Motor Co., Dearborn, Mich. 48121
Publ: HS-025 176 (SAE-P-78), "Designing for Automotive Corrosion Prevention," Warrendale, Pa., 1978 p123-7
Rept. No. SAE-780909; 1978; 20refs
Conference held in Troy, Mich., 8-10 Nov 1978.
Availability: In HS-025 176

HS-025 192

SALTING PRACTICES. TRENDS AND ISSUES

The use of salt (sodium chloride) as a deicing agent in the winter maintenance of streets and highways is an indispensable tool for road agencies. Experimental attempts to deal with snow storms in several northern cities, using only plows and no salt, were unsuccessful. Though deicing salt is a significant cause of automobile corrosion, atmospheric conditions are also a factor. Research is proceeding on a number of possible substitutes for salt. Increased use will probably be made of calcium chloride, to help trigger the action of sodium chloride, particularly at lower temperatures. Adverse impacts of salt are being minimized by new salt management and control practices, such as calibration of salt application machinery, use of ground oriented, speed-control spreaders, use of underbody blades and brush and blower systems for snow removal, use of liquid calcium chloride to augment sodium chloride, substitution of slag for sand, and early start on snow removal. Training of drivers and supervisors and maintaining uniform and accurate records of snow removal operations are also recommended. The automotive designer, recognizing the corrosive environment in which vehicles must operate, should develop the designs, processes and procedures to minimize corrosion of the vehicles and their components.

by Donald H. Swets
American Public Works Assoc., Kalamazoo, Mich.
Publ: HS-025 176 (SAE-P-78), "Designing for Automotive Corrosion Prevention," Warrendale, Pa., 1978 p128-32
Rept. No. SAE-780905; 1978; 15refs
Conference held in Troy, Mich., 8-10 Nov 1978.
Availability: In HS-025 176

HS-025 193

THE EFFECTS OF ADDING SAFE DRIVING CONTENT TO WRITTEN LAW TESTS ADMINISTERED TO ORIGINAL DRIVERS LICENSE APPLICANTS. AN EVALUATION OF THE ORIGINAL APPLICANT'S WRITTEN TEST COMPONENT OF CALIFORNIA'S SELECTIVE TESTING PROGRAM

A group of original California driver's license applicants, composed of experienced (out-of-state) drivers and inexperienced (first-time) applicants, were administered new, expanded, written licensing tests that test vehicle code law knowledge and knowledge of other safe-driving principles. A control group received standard Dept. of Motor Vehicles (DMV) law tests following standard procedures. Two passing standards were evaluated for each test series. This experiment was one of a series of related experiments that evaluated a program for selective testing of driver's license applicants according to the quality of their driving records or other factors related to expected collision and conviction frequencies. The results for the

12-month period following written testing indicate no differential effects on subsequent driving records for out-of-state drivers. First-time applicants who were administered new tests with passing standards most similar to standard law tests had more collisions in the year following testing than the standard DMV law test group. Test score correlations with subsequent driving records were similar for the two test series, and indicate a slight tendency for applicants who obtained better scores to have fewer traffic convictions than applicants who made more written test errors. Because no identifiable safety benefits appear likely from adopting the expanded law and safe driving forms and additional costs would be incurred, it is recommended that this component of the selective testing program not be implemented.

by David W. Carpenter
California Dept. of Motor Vehicles, Res. and Devel. Section, Sacramento, Calif.
Rept. No. CAL-DMV-RSS-78-65; 1978; 32p 10refs
Availability: Corporate author

HS-025 194

AN EVALUATION OF ALCOHOL ABUSE TREATMENT AS AN ALTERNATIVE TO DRIVERS LICENSE SUSPENSION OR REVOCATION. FINAL REPORT TO THE LEGISLATURE OF THE STATE OF CALIFORNIA IN ACCORD WITH CHAPTER 890--1977 REGULAR LEGISLATIVE SESSION (SENATE BILL 38--GREGORIO)

A judicial sentencing strategy for DUI (driving under the influence) offenders was created in California through passage of Senate Bill 330 (Gregorio, 1975) which permits drivers convicted of multiple offenses to participate in a 12-month alcohol abuse treatment program in lieu of mandatory suspension or revocation of their driving privilege. Prior to this legislation, a second DUI conviction in five years required a 12-month license suspension, while a third or subsequent conviction in seven years resulted in a mandatory three-year license revocation. The 1975 legislation permitted a demonstration of the treatment sentencing strategy in four California counties, beginning Jan 1976. An evaluation of these SB 330 demonstration projects was made by comparing data compiled from the demonstration counties with four comparison counties. Conviction and accident history data from the official driver record were gathered three years prior to, and one year after, the DUI conviction resulting in program entry or mandatory license suspension/revocation. Analysis of covariance procedures were employed to provide statistical control of differences that might exist between the two groups, other than the availability of the SB 330 treatment program. The duration of specific traffic safety impact was measured through survival-rate analyses. Proportions of drivers remaining free of DUI offenses or accident involvement were compared over the one-year follow-up period. Changes in a driver's lifestyle were assessed using the Life Activities Battery. The general deterrent effect of SB 330 was also analyzed. Analysis of the data has shown that SB 330 and its later legislative revisions have provided a multiple DUI offender with an alcohol abuse treatment program that demonstrates no advantage over mandatory licensing controls with respect to either traffic safety or lifestyle indicators. The program has produced operational benefits which include the provision of a format for long-term treatment programs for multiple DUI offenders, an impetus to change treatment referral from a preconviction to a postconviction format, and better coordination between the activities

of Dept. of Motor Vehicles and the Dept. of Alcohol and Drug Abuse to prevent multiple program participation. Recommendations are presented for obtaining a greater impact on traffic safety and driver lifestyle including elimination of first offenders from programs of this type.

by Roger E. Hagen; Rickey L. Williams; Edward J. McConnell; Charles W. Fleming
California Dept. of Motor Vehicles, Res. and Devel. Section, Sacramento, Calif.; California Dept. of Alcohol and Drug Abuse, Div. of Alcohol Abuse and Alcoholism, Sacramento, Calif.; Mott-McDonald Associates, Inc., Sacramento, Calif.
OTS-057701

Rept. No. CAL-DMV-RSS-78-68; 1978; 131p 50refs
Availability: Corporate author

HS-025 195

SHOPPING FOR OPTIONS [AUTOMOBILES]

Too many new-car buyers shop for flashy and expensive gadgetry, overlooking the often less-expensive items that will improve driveability and offer the greatest return on dollars invested when the automobile is sold or traded. The total cost of options may nearly equal that of the vehicle's base price. Dealers seldom stock cars equipped with the lower-cost options that improve driveability; unless a car in stock is equipped exactly as the purchaser requires, it is advisable not to buy the car off the lot. Using the 1979 Chevrolet Malibu as an example, descriptions and prices are given for the basic options most useful to a new-car buyer, as well as various categories of additional options. Relatively inexpensive items that will make any car a more roadworthy and efficient vehicle include heavy-duty battery (\$20), radiator (\$33), and suspension (\$22); also recommended for those who drive in the snow-belt or order a large V-8 automobile is a limited-slip differential (\$64). Options important in overall appeal and driveability, to be considered essentials because of their resale value, include automatic transmission (\$335), power steering (\$163), tilt steering wheel (\$175), power brakes (\$76), electric rear-window defogger (\$99), and air conditioning (\$562). Functional add-ons, relatively low in cost and to be included on a car if affordable, include left- and right-side, remote-control mirrors (\$68), gauge package (\$57), intermittent wipers (\$38), auxiliary lighting (\$50), protective side moldings (\$53), extra insulation (\$51), and power antenna (\$47). Other options, most of which are rather expensive but worth the extra cost and others which are purely for appearance sake, include comfort items (seats, special interior trim packages), power options (6-way power seat, power windows, electric door locks, power trunk opener), the music options (AM/FM radios, stereo multispeakers, electronic radios with pushbutton search and scan and precise digital display and tuning, Citizens Band radios), open roofs, and electronics (on-board computers).

by Fred Stafford
Publ: Motor Trend v31 n2 p68-70, 73-4 (Feb 1979)
1979

Availability: See publication

HS-025 196

SPRAY PROTECTORS TESTING OF EFFICIENCY [TRUCK SPLASH AND SPRAY SUPPRESSION]

Nine new spray-protector designs for heavy-vehicle tires were evaluated, including the standard Swedish spray protector as stipulated by the National Swedish Road Safety Office. Spray

generation was measured using a two-axle truck (rear wheels only) on a test track at 70 kph and 90 kph, at two water depths (1.5 mm and 2 mm). The seven new protector designs (one U.S. type, Monsanto's Spray Guard, the other six types from Sweden) are based on either the principle of directing streams and spray around the wheels in appropriate ways, the principle of reducing the impact-generated, fine spray preventing it from reentering the air streams. The spray was measured using a new method involving the measurement of the spray-induced reduction of visibility (light transmission) transverse to the driving direction as well as 1 m to the side of the vehicle. From an analysis of the measurements, curves of spray spatial distribution behind and beside the vehicle were produced, as well as overall figures representing an average reduction of visibility for the respective spray protectors. Subjective estimations of spray generation were also made, based on comparison of slides produced from film taken during the testing. It appears that the most efficient spray protector, called GW 1 (a patented invention), reduced the spray intensity by 30% to 45% compared to the standard Swedish spray protector. The GW 1 device consists of an expanded metal grid placed on the inside of the existing standard fender and also on the mud flap. All new spray protectors, except one Swedish invention, were found to be more effective than the standard type. Also tested were uncovered wheels which produced extremely intensive spray, but only very near to the vehicle.

by Ulf Sandberg
Statens vag- och trafikinstitut (VTI), Fack, S-58101 Linköping, Sweden

Rept. No. VTI-171A; 1978; 84p 15refs
English edition. Sponsored by Swedish National Board for Technical Devel., Andrzej T. Iwanicki (Sweden), Marknads-Innovator A.B. (Sweden), Monsanto (Deutschland) G.m.b.H. (West Germany), and National Swedish Road and Traffic Research Inst. (VTI).

Availability: Corporate author

HS-025 197

MANAGEMENT OF THE TRAFFIC CRASH RISK: A CONCEPTUAL FRAMEWORK

Major concepts that have served the field of the highway safety as meta-theory are reviewed critically and their limitations discussed. The need for theory is stressed as a rational consistent basis for analysis and action. A conceptual framework for the highway safety process is presented as a step toward theory. The framework has three basic elements: the Highway Transportation System, society, and risk-management systems. The basic elements of risk management are identified (identification of risk, establishment of priorities among risks, determination of allocation of resources, selection of risk-management strategies, implementation of risk management actions, and evaluation of outcomes in terms of risk reduction) and their application in the highway safety context described. Using the conceptual framework to examine past and current problems in highway safety, the author identifies some areas in which research should be pursued. It is concluded that immediate emphasis should be placed on developing an organized body of theory of highway safety. Priority should be given to improving the use of existing knowledge about the traffic crash risk and methods for managing that risk. Emphasis should be placed on understanding the role that human factors play in crash causation and on losses; risk-management strategies that effectively deal with these factors should receive priority attention. The general

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HS-025 200

concept of highway safety should be broadened and more disciplines encouraged to study problems of crashes and crash losses.

by Kent B. Joscelyn; Ralph K. Jones
Publ: Journal of Safety Research v10 n4 p1 p148-61 (Winter 1978); 31refs
Sponsored by Motor Vehicle Manufacturers Assoc.; continuation of research sponsored by National Hwy. Traffic Safety Administration.
Availability: See publication

HS-025 198

AN EVALUATION OF THE DEPARTMENT OF TRANSPORTATION'S ALCOHOL SAFETY ACTION PROJECTS

An evaluation of 35 Alcohol Safety Action Projects (ASAP's) for the period 1971 through 1976 was conducted using nighttime (8 PM to 8 AM), fatal crashes as the criterion measure in lieu of alcohol-related crashes, and roadside surveys of drivers' blood alcohol content (BAC) as an intermediate measure of project impact. A time-series analysis was used to evaluate changes in the nighttime, fatal crash levels of the ASAP's and of 11 comparison sites. Of the 35 ASAP's examined, 12 sites had significant crash reductions during their demonstration period. The reductions associated with the ASAP program varied from 15% to 66% of the baseline, nighttime, fatal crash level. In none of the comparison sites associated with these 12 ASAP's was there a significant reduction in nighttime, fatal crashes. Roadside surveys of drivers' BAC levels were conducted for 8 of the 12 ASAP sites with significant reductions in nighttime, fatal crashes. As a group, these eight sites showed a significant reduction in the proportion of drivers with illegal BAC levels (greater than or equal to .10%). Surveys of BAC levels were also conducted for 11 of the 23 ASAP sites that did not have a significant reduction in nighttime, fatal crashes. As a group, these 11 sites did not show a significant reduction in the proportion of drivers with illegal BAC's.

by Paul Levy; Robert Voas; Penelope Johnson; Terry M. Klein
National Hwy. Traffic Safety Administration, Washington, D.C. 20590
Publ: Journal of Safety Research v10 n4 p162-76 (Winter 1978); 52refs
See also HS-025 199.
Availability: See publication

HS-025 199

THE SPECIFIC DETERRENT EFFECT OF ASAP [ALCOHOL SAFETY ACTION PROJECTS] EDUCATION AND REHABILITATION PROGRAMS

Evaluation studies of Alcohol Safety Action Projects (ASAP's) in 35 locations for the period 1971 through 1976 were reviewed to see if reductions in drunk driving arrests occurred subsequent to drinking-driving offenders' participation in education and rehabilitation programs. Programs were reviewed by type of drinker (all, social, problem) and type of program (any rehabilitation, school, or nonschool). The following three types of information sources were utilized: project-level evaluation studies, aggregate re-arrest data analysis, and a controlled short-term rehabilitation evaluation study of 11 projects. The

results indicated a small positive effect for social drinkers but none for problem drinkers. Schools of all types appeared to have an effect in deterring social drinkers. It was found that some small, group-participation schools may have a slight positive effect on problem drinkers, but lecture classes have no effect or a negative effect. Group therapy programs also were found to have little effect on problem drinkers. It is hoped that these results can serve as a stimulus for increased development and evaluation of ASAP education and rehabilitation programs in the future.

by James L. Nichols; Elaine B. Weinstein; Vernon S. Ellingstad; David L. Struckman-Johnson
National Hwy. Traffic Safety Administration, Office of Traffic Safety Programs, Washington, D.C. 20590; University of South Dakota, Driver Behavior Lab., Vermillion, S. Dak.
Publ: Journal of Safety Research v10 n4 p177-87 (Winter 1978); 12refs
Adapted from a paper presented at National Safety Congress, Chicago, Oct 1978. See also HS-025 198.
Availability: See publication

HS-025 200

THE WHITE MODEL 4-210 AGRICULTURAL TRACTOR

Characteristics are described (including specifications) of the Model 4-210 Field Boss tractor, the latest articulated four-wheel drive (4wd) tractor to be manufactured by the White Farm Equipment Co. A major objective in its design was to incorporate the improved features of White's new, large, two-wheel drive (2wd) tractors by using as many common components as possible. The design philosophy implemented (1974) in the White Model 4-150 Field Boss, and later in the Model 4-180, has been continued in the 4-210. The design features a low-profile, low-center-of-gravity configuration which utilizes the final drive/axle assemblies from the larger 2wd tractors, most of their transmission components, and a straight-through power take-off (PTO) drive which eliminates the usual drop box or transfer case. This "family" approach allows use of the basic hydraulic system, independent PTO, hitch, and drawbar components from the larger 2wd tractors. The use of these common parts results in significant manufacturing economies, as well as in obvious simplification of parts inventories and training of service personnel, and the many other benefits of standardization. Another characteristic of White's earlier 4wd tractors, retained (in modified form) in the 4-210, is the combination articulation/oscillation joint at the center of the tractor. Both articulation and oscillation take place about one main spherical bearing, maintain stability between the front and rear halves of the tractor. The fiberglass hood and side panels used on the 4-180 have been replaced by sheet steel to reduce cost and to utilize existing 2wd tooling. It is no longer necessary to remove the side panels to perform routine service operations, as the air cleaner, radiator, and fuel-tank fillers are all accessible from the top of the hood. Like the earlier models, the 4-210 is intended for a broad range of farming operations; it therefore features a fully-independent PTO, three-point hitch with draft and position control, quick coupler, standard and wide-swinging drawbars, and adjustable-tread wheels.

by Richard J. Garrity
White Farm Equipment Co.
Rept. No. SAE-780727; 1978; 16p 4refs
Technical Paper Series. Presented at Off-Highway Vehicle Meeting and Exposition, Milwaukee, 11-14 Sep 1978.
Availability: SAE

HS-025 201

ELECTRONICS ON WINGS, WHEELS, AND WAVES [TRANSPORTATION SYSTEMS]

Sophisticated electronic equipment is increasingly being developed and applied to improve land, air, and sea transportation systems. Equipped with sensors, processing, display, and power-conditioning units, a system developed by the Transportation Systems Center (TSC) which is mounted on a train checks the alignment of railroad tracks. A technique has been devised to detect the defects in railroad tracks by analysis of echoes from several ultrasonic beams impinging on the rails; the Federal Railroad Administration recently obtained a special highway-rail vehicle from TSC to carry this system. Microprocessor control of an entire propulsion system was tested successfully last year in Rio de Janeiro aboard a six-car train. Rio plans to use some 300 microprocessor-controlled cars in its transit system, and similar applications are expected in U.S. cities. In transit traction and auxiliary power applications, solid-state thyristor inverters, using the classic AC squirrel-cage motor, promise to become an alternative to conventional techniques that employ DC motors. A new rail transit system is being built in England (Tyne and Wear Metro) which has computer-based remote control and employs time-division multiplex techniques. The Urban Mass Transportation Administration (UMTA) is sponsoring and TSC is developing automatic vehicle monitoring networks for public transit systems. Development of automated guideway transit (downtown people mover) systems is also being sponsored by UMTA. Microprocessor-based control electric vehicles are being developed under the sponsorship of the Dept. of Energy. An automatic weather-reporting system for general-aviation pilots has been developed as part of a Federal Aviation Administration program. TSC is working on a laser-equipped system that senses and monitors the wake turbulences created by aircraft at airports, and on automatic surface-detection equipment to help airport traffic controllers track aircraft on the ground. The Coast Guard recently tested a marine monitoring system made up of long-range navigation radio, and minicomputer equipment that continuously pinpoints vessel movements near coasts.

by Gadi Kaplan

Publ: IEEE Spectrum v16 n1 p67-70 (Jan 1979)

1979; 3refs

Availability: See publication

HS-025 202

FOUR-WHEEL DRIVE: HOW THE POWER GETS WHERE YOU WANT IT

The mechanical operation of the two basic forms of four-wheel drive (4wd), part-time and full-time, and their several variations are explained and illustrated. As with all 4wd, the part-time system begins with the transfer case, an additional gearbox bolted to the conventional transmission to provide a dual source for power transfer. Two propeller shafts are connected into the transfer case, one going to the conventional rear-axle differential and the second to a front-drive axle differential. The transfer case, controlled by a shaft lever, generally provides a choice of high or low ratios in 4wd, a single ratio for 2wd, and perhaps a neutral position for a stationary power takeoff (winch, etc.). Since the front wheels must turn for steering, the front axle differs from the conventional rear one. The shafts are exposed at the ends of the axle tubes, where each shaft has a universal joint, permitting swivelling

when the steering knuckle is turned while transferring power to the wheel. Part-time 4wd can be used safely only when traveling at low speed off-road, for the transfer case always provides equal power to each axle. In normal operation at cruising speeds, power requirements of the axles vary. With a full-time system, 4wd can be used for on-road and off-road operation. The simplest full-time 4wd has a differential built into the transfer case, to divide the power between front and rear axles according to demand. As with the part-time system, there is a choice of two 4wd gear ratios, and a shift lever position which allows locking of front and rear propeller shafts together. This lockup feature (in effect, the same as an engaged part-time system) lets the vehicle keep moving if one wheel or axle is slipping badly. The most sophisticated full-time system is the Jeep Quadra-Trac which can be combined with automatic transmission. Quadra-Trac has a limited-slip differential in the transfer case, dividing power between the front and rear wheels as traction dictates. Combined with the automatic transmission, Quadra-Trac offers the capability of switching from off-road to on-road and vice versa without shifting. In Subaru's 4wd, which has independent suspension, the 4wd transfer case is housed with the front-wheel drive transaxle and differential; the car is put in 4wd by moving a shift lever in the passenger compartment of the car to mate the transaxle with the rear-axle differential. The result of Subaru's approach is a lightweight, lowest-cost 4wd.

by Paul Weissler

Publ: Popular Mechanics v151 n2 p98-9, 137 (Feb 1979)

1979

Availability: See publication

HS-025 203

FOUR-WHEEL DRIVE: HOW TO KEEP IT WORKING

Maintenance procedures for four-wheel drive (4wd) vehicles are prescribed for the vehicle owner. It is pointed out that many routine maintenance intervals on a 4wd vehicle are much shorter than on a conventional passenger car, and that the 4wd requires checks and services not required by the passenger car partly due to the terrain in which the 4wd operates. The 4wd needs a total of perhaps a few days a year of extra maintenance. Instructions (and some accompanying photographs and illustrations) are provided for 4wd vehicle cleaning (brake parts, universal joints of propeller shafts and front-axle shafts, transmission and/or fuel tank skid plates) and tightening (engine oil filter, exhaust system hangers and clamps, shocks, leaf-spring brackets, transmission mount, and steering linkage), lubrication (fittings on the propeller shafts, steering linkage, and steering shaft), oil changes (differential and transmission oil), and maintenance of wheels and hubs.

by Paul Weissler

Publ: Popular Mechanics v151 n2 p138-40, 182 (Feb 1979)

1979

At head of title: Saturday Mechanic.

Availability: See publication

HS-025 204

ELECTRIC VEHICLE SIMULATION PROGRAM

A digital computer simulation program, EVSIM, has been developed to study electric vehicle (EV) performance. The program is sufficiently detailed to evaluate the effects on both

age is modeled as a function of battery current and depth of discharge. Charge depletion of the batteries is accumulated as the vehicle follows the acceleration and speed requirements of a chosen driving schedule. The motor voltage and current are determined from the motor torque and speed required to meet vehicle road load and acceleration. Both the battery and motor data are entered as tables, and required currents and voltages for specific operating points are calculated using two-dimensional linear interpolation. The SCR (semiconductor controlled rectifier) chopper model is based on curve fits of input and output power to motor torque and speed with calculations verified by experimental data. Motor and choke AC losses due to current ripple are calculated separately and included in the program. Comparison of simulation results and test data on a 1500 kg EV shows good agreement between estimated and measured voltages, currents, and range.

by Robert H. Nelson; Linos J. Jacovides; Frank J. Schauerte; Edward J. Woods
General Motors Res. Labs., Electrical Engineering Dept., Warren, Mich. 48090
Rept. No. GMR-2758; 1978; 11p 10refs
Presented at 5th International Electric Vehicle Symposium, Philadelphia, 2-5 Oct 1978 (published in Conference Proceedings).
Availability: Corporate author

HS-025 205

A DATA BASE ON TRAFFIC FATALITIES

A description is presented of the evolution since 1975 and the current status of the Traffic Injury Res. Foundation of Canada's (TIRF) national data base on collision traffic fatalities. The TIRF file is more comprehensive than other reporting systems in that all off-road deaths, such as those from snowmobile and dune buggy accidents and those involving pedestrians on private property, are included. The data base currently contains information on 20,813 victims, representing all traffic fatalities for all Canadian provinces except Nova Scotia, Newfoundland, and regions of Quebec outside the Greater Montreal Area. The data are complete in all the study provinces from 1973 to 1976, inclusive, and are historically intact prior to 1973 in some provinces. The data originate from coroners'/medical examiners' files, with the accompanying toxicology report which provides data on alcohol and other drugs; and from police accident reports, which provide some details on the circumstances surrounding a crash. The basic data available on all 20,813 victims, excluding confidential identifiers, are as follows: year of death, province, hour of crash, day of week, month and year of crash, type of vehicle driven or occupied by victim, type of vehicle in collision with crash vehicle, collision type (single or multiple), victim classification (driver, passenger, pedestrian), age and sex of victim, time elapsed from the crash until the death of the victim, any alcohol determinations or drug tests performed on the victim, and the established medical causes of death. Expanded data, up to 81 variables on the victim, vehicle, and environment, are available for 3085 drivers and 1275 pedestrians. The

by H. M. Simpson; L. Page-Valin; R. A. Warren
Publ: Canadian Society of Forensic Science Journal v11 n3
p215-20 (1978)
1978; 10refs
Includes French summary. Version of this paper presented at Annual Meeting of Traffic Injury Res. Foundation of Canada, Toronto, 1 Jun 1978.
Availability: See publication

HS-025 206

CONVERGENCE 78. INTERNATIONAL CONFERENCE ON AUTOMOTIVE ELECTRONICS PROCEEDINGS. DEARBORN, MICHIGAN, SEPTEMBER 25-27, 1978

Twenty studies are presented on the role of electronics in automotive engine control. These include discussions of LSI (large scale integrated circuits) technologies in power train control; an expandable microcomputer multifunction vehicular information system; electronic reliability issues relative to automotive products; and electronic applications to the automobile. Also considered are the status of automotive electronics in Japan; a systems approach to automotive engine control; automotive electronics from an R and D (research and development) electronic engineer's viewpoint; electronic engine controls at Ford; and Chrysler's digital spark timing computer. The application of systems engineering methods to the electronic engine control problem, and methods of making new technology effective are described, as well as progress in electric and hybrid vehicles. The role of modern control theory for automotive engine control is discussed, as is the electromagnetic compatibility of automotive vehicles, with an analysis of possible assurance methods. Further articles concern an electronic braking system, a doppler radar speed sensor for anti-skid control system, Minicars' Research Safety Vehicle, emission control at General Motors, and a study of electronic subsystems available on current production automobiles.

Society of Automotive Engineers, Inc., 400 Commonwealth Dr., Warrendale, Pa. 15096
Rept. No. SAE-P-76; IEEE-78CH1343-3 VT; 1978; 174p refs
Includes HS-025 207-HS-025 226.
Availability: SAE

HS-025 207

POWER TRAIN CONTROL: A CONVERGENCE ON LSI [LARGE SCALE INTEGRATED CIRCUITS] TECHNOLOGIES

A review is made of the present use of large scale integrated circuit (LSI) technology in automotive power train control, with a discussion of the requirements of future engines. Electronic control of these power trains will require a number of technologies to perform various functions. These technologies, including N-channel metal oxide semiconductor (NMOS); high performance MOS (HMOS); electrically programmable read-only memories (EPROM's), including floating avalanche MOS (FAMOS), electrically erasable or electrically alterable read-only memories (EEPROM's). The functions of these technologies and others will be combined on single-chip power train control microcomputers. Analog capability will be combined with HMOS, with continual improvement in resolution, lineari-

ty and accuracy. Promising future technologies include low voltage HMOS and silicon on sapphire (SOS); the latter, although expensive, is ideal for applications requiring very low power dissipation with high performance. For large non-volatile memories, magnetic bubbles are being developed. Improvement in microcomputer architectures permits fuller utilization of the performance made possible by new process technologies. New design techniques and careful manufacturing will make such components inexpensive and highly reliable.

by Robert N. Noyce
Intel Corp.

Publ: HS-025 206 (SAE-P-76; IEEE-78CH1343-3VT),
"Convergence 78. International Conference on Automotive Electronics Proceedings," Warrendale, Pa., 1978 p1-7
Rept. No. SAE-780831; 1978
Conference held in Dearborn, Mich., 25-27 Sep 1978.
Availability: In HS-025 206

HS-025 208

AN EXPANDABLE MICROCOMPUTER MULTIFUNCTION VEHICULAR INFORMATION SYSTEM

The features and development of an expandable, microprocessor-based vehicle operator information system (Cadillac's TRIP COMPUTER) are described. An eleven-function driver information system utilizing digital displays was developed and introduced on 1978 Cadillac Seville, based on an N-channel, 8-bit parallel processing central processing unit (CPU) with expandable memory, allowing changes in the coding of selectable functions. Information sensing, software routines, hardening techniques and display methods are presented, with photographs of components and block diagrams. Quality controls and field servicing are covered, as well as potential future applications of the microprocessor to engine control and vehicle subsystems. Valuable experience was achieved in the automotive use of digital processors, especially in the areas of input circuit isolation, the need for software redundancy and refresh cycles for critical data, reliable wiring interconnects, precise quality control procedures, and adequate diagnostic and field service procedures for complex electronic systems.

by R. J. Templin
General Motors Corp., Cadillac Motor Car Div.
Publ: HS-025 206 (SAE-P-76; IEEE-CH1343-3VT),
"Convergence 78. International Conference on Automotive Electronics Proceedings," Warrendale, Pa., 1978 p8-17
Rept. No. SAE-780832; 1978
Conference held in Dearborn, Mich., 25-27 Sep 1978.
Availability: In HS-025 206

HS-025 209

ELECTRONIC RELIABILITY ISSUES RELATIVE TO AUTOMOTIVE PRODUCT

The need for improved and predictable reliability for automotive electronics is considered. Reliability enhancement requires improvements in packaging, testability, device design and fabrication processes. Standard parts must have supplemental reliability specifications and qualification; custom parts should make maximum utilization of proven ingredients to avoid long trial-and-error learning curve delays. Besides temperature and humidity variation, electromagnetic interference is a problem. Electronic components must have reliability designed-in rather

than "yielded-in". Also needed are improvement in predictions of reliability performance in the field and alternatives to screening techniques to eliminate premature mortality. Automotive and electronic engineers must cooperate fully to meet the challenge of putting high reliability electronics on the road.

by J. G. Rivard
Ford Motor Co., Electrical and Electronics Div., Dearborn, Mich.
Publ: HS-025 206 (SAE-P-76; IEEE-78CH1343-3VT),
"Convergence 78. International conference on Automotive Electronics Proceedings," Warrendale, Pa., 1978 p18-22
Rept. No. SAE-780833; 1978
Conference held in Dearborn, Mich., 25-27 Sep 1978.
Availability: In HS-025 206

HS-025 210

ELECTRONIC APPLICATIONS TO THE AUTOMOBILE BY ROBERT BOSCH GMBH

The beginnings of automotive electronics are described, including early products introduced by Robert Bosch G.m.b.H., such as the Variode, a regulator for DC-generators; a transistorized ignition system; an electronically controlled gasoline injection system, the "D-Jetronic"; and a more advanced successor, the "L-Jetronic". Important current products include electronic fuel injection, breakerless ignition systems, and the antiskid system. The L-Jetronic, which directly utilizes the intake mass air flow to meter the fuel quantity, can be expanded with a few modifications into a closed loop control system, in which an oxygen sensor maintains the air/fuel mixture at a stoichiometric ratio with very high accuracy, so that emission control can be obtained by means of a three-way catalyst. The development of future products is considered, involving use of digital technology and often a microcomputer; the most significant project is the digital engine control to manage gasoline injection, ignition and automatic transmission. Other future products include multiplex wiring harness, malfunction monitoring systems, electronic seat adjustment, air bag triggering systems, and collision avoidance radar. The components are presented in detail by charts, diagrams and photographs.

by Herman Scholl
Robert Bosch G.m.b.H., 7000 Stuttgart 30, Federal Republic of Germany
Publ: HS-025 206 (SAE-P-76; IEEE-78CH1343-3VT),
"Convergence 78. International Conference on Automotive Electronics Proceedings," Warrendale, Pa., 1978 p23-39
Rept. No. SAE-780834; 1978; 7refs
Conference held in Dearborn, Mich., 25-27 Sep 1978.
Availability: In HS-025 206

HS-025 211

THE STATUS OF AUTOMOTIVE ELECTRONICS IN JAPAN

Japanese emission standards, first implemented in 1966, have become more stringent, leading to the development of much new technology. The D-Jetronic, an electronic fuel injection system, detected the main variables of manifold pressure and engine speed to supply the correct amount of fuel to the engine; a more advanced system, the L-Jetronic, detects the air-flow rate and engine speed, and also employs an oxidizing catalyst. In 1978, a system with closed-loop control was introduced, consisting of a three-way catalyst, an oxygen sensor

and an air/fuel ratio controller. A carburetor system employing a modified carburetor combined with the three-way catalyst closed-loop system maintains a steady air/fuel ratio under changing driving conditions and improves performance. Electronic ignition systems are being used increasingly, as are semiconductor regulators. Other electronic devices described include automotive clocks; a central processing unit for warning lights, wiper/washer circuits, and condition monitoring devices; entertainment systems; anti-skid; and mobile telephone systems. Research is continuing on systems for comprehensive traffic control, radar, and multiplex wiring systems.

by Ryoichi Nakagawa
Nissan Motor Co., Ltd., Tokyo, Japan
Publ: HS-025 206 (SAE-P-76; IEEE-78CH1343-3VT),
"Convergence 78. International Conference on Automotive Electronics Proceedings," Warrendale, Pa., 1978 p40-3
Rept. No. SAE-780835; 1978
Conference held in Dearborn, Mich., 25-27 Sep 1978.
Availability: In HS-025 206

HS-025 212

TI [TEXAS INSTRUMENTS] VIEW OF AUTOMOTIVE ENGINE CONTROL. A SYSTEMS APPROACH

Trends in semiconductor technology in the past two decades are described and projected through the mid-1980's. Reductions in cost and increased reliability in computing systems will continue with the increasing number of active element groups (AEG's) per chip. A systems approach to the design of automotive electronics utilizing a digital information system is presented; the Air Force approach, Digital Avionics Information System, could be adapted to the problems of the automotive industry. The system consists of four basic elements: a set of sensors that provide input data; an information data base that distributes information throughout the vehicle in a common format; an information processing system that performs data processing and storage; and an information presentation, control, and actuation system that provides the required display and control signals. Benefits of this approach include easier system modification, greater reliability through redundancy, greater flexibility in adding new sensors, actuators and other functions, and effectiveness in using modular or common electronic equipment across a fleet of vehicles. A strategic approach to implementing this digital information system into automotive systems is presented.

by Bernard H. List
Texas Instruments Inc., Houston, Tex.
Publ: HS-025 206 (SAE-P-76; IEEE-78CH1343-3VT),
"Convergence 78. International Conference on Automotive Electronics Proceedings," Warrendale, Pa., 1978 p44-50
Rept. No. SAE-780839; 1978; 1ref
Conference held in Dearborn, Mich., 25-27 Sep 1978.
Availability: In HS-025 206

HS-025 213

THE ROLE OF ELECTRONICS IN AUTOMOTIVE ENGINE CONTROLS

Due to the impetus of fuel economy and emissions regulations, automotive engine control is one of the fastest growing electronic applications in the industry. Fuel control offers the best example to suggest some of the directions for cost reductions, and areas where the more complex but expensive electronic

control systems will be of benefit. The performance potential of the more complex engine controls systems is explored, including electronic spark advance, multipoint fuel injection and integrated electronic modules. A promising development is that of micro control, the sensing and response to each individual combustion event. Diagrams include the schematic comparison of closed loop carburetor control and electronic fuel injection, the electronic fuel injection system, single point injection, single point throttle body injection system, linear variable differential transformer manifold absolute pressure sensor, and multipoint fuel injection.

by Charles D. Flanagan
Bendix Corp.
Publ: HS-025 206 (SAE-P-76; IEEE-78CH1343-3VT),
"Convergence 78. International Conference on Automotive Electronics Proceedings," Warrendale, Pa., 1978 p51-6
Rept. No. SAE-780840; 1978; 1ref
Conference held in Dearborn, Mich., 25-27 Sep 1978.
Availability: In HS-025 206

HS-025 214

AUTOMOTIVE ELECTRONICS FROM AN R AND D [RESEARCH AND DEVELOPMENT] ELECTRONIC ENGINEER'S VIEWPOINT

The development of reliable, complex electronic control systems is still at an early stage, comparable to the state of the art of transistor radios in the early 1950's. To date, emphasis seems to be on initial component cost rather than on system life cycle costs, including servicing. Environmental specifications are being relaxed in favor of lower cost; the automotive manufacturer is putting microprocessors in the passenger compartment rather than in the engine compartment to minimize environmental problems. This entails long input signal lines from the engine compartment to the microprocessor, and long control lines back through the firewall to the engine compartment, a more complicated installation problem, with more susceptibility to electromagnetic interference for the total system. It is predicted that in the long run, the more complex complementary metal oxide semiconductor (CMOS) technology will prove to be more cost effective than simpler N-channel MOS (NMOS) technology.

by Gerald B. Herzog
RCA Labs., Princeton, N.J. 08540
Publ: HS-025 206 (SAE-P-76; IEEE-78CH1343-3VT),
"Convergence 78. International Conference on Automotive Electronics Proceedings," Warrendale, Pa., 1978 p57-8
Rept. No. SAE-780841; 1978
Conference held in Dearborn, Mich., 25-27 Sep 1978.
Availability: In HS-025 206

HS-025 215

ELECTRONIC ENGINE CONTROLS AT FORD MOTOR COMPANY

A discussion is presented of the 1979 Electronic Engine Control - II (EEC-II) System developed by Ford. Using seven sensors that measure such engine parameters as crankshaft position, exhaust gas oxygen content (air/fuel) ratio, EGR (exhaust gas recirculation) valve position, ambient and engine manifold pressure, throttle position and engine coolant temperature, a high-speed digital computer controls ignition timing, EGR, air/fuel ratio, canister purge and thermactor air. This system involves entirely new products such as the com-

posite barometric and manifold absolute pressure sensor as well as new custom Large Scale Integrated (LSI) circuits to support the basic control assembly. The most significant advantage is the system's ability to optimally control the key engine functions throughout each of the three major engine modes: idle, part throttle and wide-open throttle. Components described include the processor and calibration assembly, sensors for crankshaft position, throttle position, barometric and manifold absolute pressure, engine coolant temperature and exhaust gas oxygen, the EGR valve and position sensor assembly, the catalytic converter assembly, the thermactor air control system, the feedback carburetor, and the ignition system. A description of engine systems strategy includes the base engine strategy for normal conditions, the modulator strategy for uncommon operating conditions (heat, cold, high altitude), and the Limited Operation Strategy (LOS) for operation under certain failure modes of the EEC Processor Assembly. The LOS allows sufficient engine operation for the vehicle to reach required assistance. Photographs of components and diagrams are included.

by D. F. Hagen

Ford Motor Co., Engine Engineering, Dearborn, Mich.
Publ: HS-025 206 (SAE-P-76; IEEE-78CH1343-3VT),
"Convergence 78. International Conference on Automotive Electronics Proceedings," Warrendale, Pa., 1978 p59-67
Rept. No. SAE-780842; 1978; 5refs
Conference held in Dearborn, Mich., 25-27 Sep 1978.
Availability: In HS-025 206

HS-025 216

CHRYSLER'S DIGITAL SPARK TIMING COMPUTER

For the effective use of microcomputer technology, made cost effective by large scale integrated (LSI) microcomputers, automotive product designers need to learn new engineering disciplines, including microcomputer software. Understanding how to evaluate hardware versus software tradeoffs to develop a minimum component count system with the flexibility to incorporate changes is a fundamental requirement for a high volume production design. An example is a microcomputer digital spark timing control unit that can be programmed during assembly to match engine specifications for four, six, or eight-cylinder engines. Photographs include the Mostek MK3870 single-chip microcomputer and a parts count comparison of the custom analog spark control computer (SCC) with the microcomputer SCC.

by J. L. Webster; J. P. Lappington

Chrysler Corp., Huntsville Electronics Div.
Publ: HS-025 206 (SAE-P-76; IEEE-78CH1343-3VT),
"Convergence 78. International Conference on Automotive Electronics Proceedings," Warrendale, Pa., 1978 p68-74
Rept. No. SAE-780844; 1978; 1ref
Conference held in Dearborn, Mich., 25-27 Sep 1978.
Availability: In HS-025 206

HS-025 217

APPLYING SYSTEMS ENGINEERING METHODS TO THE ELECTRONIC ENGINE CONTROL PROBLEM

An outline is presented of systems engineering methods as used at the General Motors Res. Labs. to explore electronic engine control research problems. Analytic tools used are modeling, a mathematical abstraction of a physical process; computer analysis and graphics; computer simulation; op-

timization, using mathematical techniques to find the best tradeoffs between design alternatives; and control theory. Present limitations in the engine control problem are the lack of sensors and actuators and of adequate mathematical models. Simplified models help to determine the maximum performance to be expected from a given set of components using microcomputer engine controls. Aspects of the closed-loop engine control are considered. Use of estimation algorithms is described. A simulation study to evaluate that aspect of the driveability problem called hesitation or sag is presented; the study led to a system of optimal control known as Coordinated Microprocessor Engine Control, with a potential for future use.

by Paul F. Chenea

General Motors Res. Labs.
Publ: HS-025 206 (SAE-P-76; IEEE-78CH1343-3VT),
"Convergence 78. International Conference on Automotive Electronics Proceedings," Warrendale, Pa., 1978 p75-8
Rept. No. SAE-780851; 1978
Conference held in Dearborn, Mich., 25-27 Sep 1978.
Availability: In HS-025 206

HS-025 218

THE ROLE OF MODERN CONTROL THEORY FOR AUTOMOTIVE ENGINE CONTROL

A discussion is given of the importance of multivariable modern control theory to the design of advanced control systems for future automotive engines. Specific areas include static (steady state) and dynamic optimization, multivariable stochastic estimation and control, and reliability issues. Static optimization techniques are necessary but not sufficient for improved automotive engine control; the stochastic and dynamic issues involved must also be examined, necessitating the development of more realistic mathematical models for automotive engine systems. With adequate models, current control design methodologies are adequate for designing multivariable control systems. These methodologies can be used to design dynamic compensators for multivariable systems without decoupling the control loops, and have reasonable robustness properties. Failure detection and management depends on accurate and reliable sensors. Techniques in estimating a variable that cannot be measured are generally derivatives of the Kalman filter and can be implemented by microprocessors. A concentrated research effort involving industry, government and universities is needed to remove key obstacles to successful development.

by Michael Athans

Massachusetts Inst. of Tech., Electronic Systems Lab.,
Cambridge, Mass. 02139
Publ: HS-025 206 (SAE-P-76; IEEE-78CH1343-3VT),
"Convergence 78. International Conference on Automotive Electronics Proceedings," Warrendale, Pa., 1978 p79-83
Rept. No. SAE-780852; 1978; 40refs
Conference held in Dearborn, Mich., 25-27 Sep 1978.
Availability: In HS-025 206

HS-025 219

MAKING NEW TECHNOLOGY EFFECTIVE

In a discussion of the application of new technology to the automobile industry, the development of a digital microcomputer with stored program control is traced from its inception to its present use as an interactive spark timing/EGR (exhaust gas

recirculation) control on the 1978 Versailles. Further potentials for computer usage are suggested, including driver selected displays and an energy management system to transfer energy from a generator to a storage device, each operating under its most efficient conditions, and to distribute the energy to the propulsion units as required. The hybrid combination of the internal combustion engine and some efficient temporary storage of energy is recommended as a better way to reduce overall gasoline consumption than the electric car. Transfer of energy from brake heat to temporary storage is considered; the concept of energy management seems most likely to require new technology in the next decade.

by David F. Moyer

Ford Motor Co., Engineering and Res. Staff, Dearborn, Mich.

Publ: HS-025 206 (SAE-P-76; IEEE-78CH1343-3VT),

"Convergence 78. International Conference on Automotive Electronics Proceedings," Warrendale, Pa., 1978 p84-91

Rept. No. SAE-780853; 1978

Conference held in Dearborn, Mich., 25-27 Sep 1978.

Availability: In HS-025 206

HS-025 220

PROGRESS IN ELECTRIC AND HYBRID VEHICLES

Recent progress in electric and hybrid vehicle development is discussed, and the additional work needed to prove their viability as alternate modes of private transportation is outlined. Problems of electric vehicles (EV's) include the requirements of carrying a large battery pack while providing adequate space for passengers or cargo, of minimizing rolling resistance and aerodynamic drag, of reducing vehicle curb weight, and of increasing the efficiency of the drive motor, motor controller, battery charger and supervisory controls. Both DC and AC (direct and alternating current) drive systems are under development; maximum efficiency in a DC drive can be enhanced by use of a separately-excited drive motor, transistorized motor controller, an on-board microcomputer for supervisory control, and the use of regenerative braking. Combining all these features, a GE DC drive system for the Near-Term Electric Vehicle program has a peak efficiency of 80% and a predicted average efficiency of 73% on the SAE J227 Schedule D driving cycle. Expanded use will be made of microcomputers for a variety of on-line and off-line control functions. The nickel-zinc battery appears to be the most promising in performance, with a projected energy density of 90 Wh/kg by 1980, at a cost of \$100 or less per kWh. This energy density, more than twice that of current lead-acid batteries, would allow a 3000-pound commuter vehicle to achieve an urban range of 100 miles or more, with good acceleration and hill-climbing. Research is under way to improve the life cycle of nickel-zinc cells. Analysis and design of a hybrid vehicle involves the selection and sizing of both heat engine and electric propulsion systems, the overall drive train configurations, and optimum control strategy for the hybrid power plant. Two basic types of hybrid drive trains are the series hybrids, in which all traction power is delivered by the electric motor, with the heat engine being used intermittently to generate electrical energy, and the parallel hybrids, in which both power plants are connected mechanically to the wheels, and either or both may operate in various driving modes. Series hybrids tend to be mechanically simpler, but less efficient. An efficient 5-passenger hybrid vehicle could be built, using a small (20-40 hp) supercharged Otto cycle or Diesel engine combined with a high-efficiency AC electric drive system; average petroleum fuel consumption could be less than 50% of current compacts. Public acceptance will depend on demon-

strated performance and operating costs approaching those of a comparably-sized internal combustion engine vehicle.

by Eugene A. Rowland

General Electric Co., Corporate Res. and Devel., Schenectady, N.Y.

Publ: HS-025 206 (SAE-P-76; IEEE-78CH1343-3VT),

"Convergence 78. International Conference on Automotive Electronics Proceedings," Warrendale, Pa., 1978 p92-9

Rept. No. SAE-780854; 1978; 12refs

Conference held in Dearborn, Mich., 25-27 Sep 1978.

Availability: In HS-025 206

HS-025 221

ELECTROMAGNETIC COMPATIBILITY OF AUTOMOTIVE VEHICLES. AN ANALYSIS OF POSSIBLE ASSURANCE METHODS

A study is presented of a systematic decision making process applied to the field of Electromagnetic Compatibility of automotive vehicles. Objectives are identified and classified by priority. Primary objectives which must be satisfied by a system test facility may be written as specifications. These must have a lead time of one year or less; must have a test volume approximately 1000 metres; be state-of-the-art; offer safe and legal operation; must be accurate within plus or minus 10 db; must have a frequency range of 10 MHz to 12.4 GHz; and must accept test levels of 200 V/M. Secondary objectives to be satisfied are: the system must be commercially available; must offer weather immunity; must not be hampered by schedule restrictions; must be free of reflections and standing waves; must provide road speed and load testing; must include a reflective ground plane; must offer minimum test time; and must require minimum site area for the test performed. Various mechanizations of possible assurance methods are listed: variations of shielded rooms, of transverse electromagnetic (TEM) or Crawford cells, and of reverberant cavities; anechoic funnel chamber; open air; and Electro Magnetic Environmental Simulator. a matrix of alternate mechanizations and objectives which they meet is assembled and the best alternate identified. Photographs and diagrams illustrate test procedures and facilities.

by John T. Auman; Joseph C. Kindermann; James J. Laggan

General Motors Corp., Engineering Staff, Warren, Mich.

Publ: HS-025 206 (SAE-P-76; IEEE-78CH1343-3VT),

"Convergence 78. International Conference on Automotive Electronics Proceedings," Warrendale, Pa., 1978 p100-10

Rept. No. SAE-780855; 1978; 15refs

Conference held in Dearborn, Mich., 25-27 Sep 1978.

Availability: In HS-025 206

HS-025 222

ELECTRONIC BRAKING SYSTEM

The need for a standard for electronic braking systems for air-brake vehicles, and the difficulty in documenting the benefits of these systems, are discussed. The antilock or antisid electronic braking system strives to maintain wheel roll during panic braking to achieve optimum retarding force consistent with lateral stability. Sixty mph panic stops with antilock can be made within 293 ft with confidence. Stopping distance and lateral stability can be demonstrated, but it is difficult to relate improved braking to a reduction in accidents. Criticism of antilock systems apparently stems from maintenance cost, misunderstanding of operation, the cost/benefit, system failures

and public resistance to government regulations. Public criticism, court and legislative action threaten to cause revocation of electronic brake regulations, and condemn them to the fate of the seatbelt inter-lock. A commitment by government, manufacturers and vehicle operators is needed to retain this dependable driver aid to safe vehicle operation.

by Edward J. Hayes; George W. Megginson
Kelsey-Hayes Co., Romulus, Mich.
Publ: HS-025 206 (SAE-P-76; IEEE-78CH1343-3VT),
"Convergence 78. International Conference on Automotive Electronics Proceedings," Warrendale, Pa., 1978 p111-3
Rept. No. SAE-780856; 1978; 4refs
Conference held in Dearborn, Mich., 25-27 Sep 1978.
Availability: In HS-025 206

HS-025 223

DOPPLER RADAR SPEED SENSOR FOR ANTI-SKID CONTROL SYSTEM

A 24 GHz doppler speed sensor for skid controls has been developed; closed loop control makes the system less sensitive to the variations of system parameters than the conventional open loop adaptive control. The design considerations are described and test results presented. The microwave sensor is designed using both waveguide and thin-film technologies and assembled into a small integrated unit measuring 27 x 10 x 9 mm. The radar unit and the control circuitry are housed in a waterproof module of 94 x 140 x 78 mm. Part of the casing forms a horn antenna, which radiates a vertically polarized beam incident at 45 degrees on the road surface, when mounted on the vehicle. The error in speed measuring is usually less than 10%.

by Kohsaku Baba; Yukitsugu Fukumori; Yoichi Kaneko;
Kenji Sekine; Akira Endo
Nissan Motor Co., Ltd., Japan; Hitachi, Ltd., Japan
Publ: HS-025 206 (SAE-P-76; IEEE-78CH1343-3VT),
"Convergence 78. International Conference on Automotive Electronics Proceedings," Warrendale, Pa., 1978 p114-9
Rept. No. SAE-780857; 1978; 3refs
Conference held in Dearborn, Mich., 25-27 Sep 1978.
Availability: In HS-025 206

HS-025 224

THE NEAR-TERM PROSPECT FOR AUTOMOTIVE ELECTRONICS: MINICARS' RESEARCH SAFETY VEHICLE

The electronics under development by RCA Laboratories for the Research Safety Vehicle (RSV) include a bi-static Ku-band FM/CW radar, COSMAC 1802 microcomputer, alpha-numeric display, and numerous electromechanical interfaces. This technology will control the following systems: warning of pathway obstacles and potential accidents; automatic collision mitigation; automatic cruise/headway control; automatic fuel economical shifting of the manual transmission; anti-skid braking; airbag impact sensing; vehicle systems status and diagnostics; operational information displays; and entertainment and communications. The Large Research Safety Vehicle, another task of the Phase III RSV program, incorporates the Volvo Lambda-Sond electronic emissions control system. The COSMAC development system, used in the second phase RSV electronics, is described and shown in a block diagram; the 10.5 GHz FW/CW radar is similarly treated. The radar provides audio-visual warning at ranges to 80 meters concerning

targets whose relative range and range rate suggest a potentially dangerous but avoidable impact. The device activates collision mitigation braking only when an impact is unavoidable and provides automated headway control by operating the cruise control system in a car-following mode. Logics of the display system are rather simple, requiring mainly software inputs from the radar system; the key interface of the system is the display interface circuit between the microcomputer and the self-scan unit, which is a single-line character, gas discharge display using two bezels and a flexible format. Other components discussed include sensors for monitoring vehicle and environmental characteristics, for water temperature, oil pressure and fuel level, and for the passive restraint system. Programs are being developed to simulate electronic control of performance, fuel economy, emissions and shifting. The anti-skid braking system employs independent front select low rear control; it has its own separate microcomputer, but could be controlled by the RCA microcomputer and thus become fully integrated with the safety, economy, performance and emissions capabilities of the main system.

by Donald Friedman; Erwin Belohoubek
Minicars, Inc.; RCA Labs.
Publ: HS-025 206 (SAE-P-76; IEEE-78CH1343-3VT),
"Convergence 78. International Conference on Automotive Electronics Proceedings," Warrendale, Pa., 1978 p120-30
Rept. No. SAE-780858; 1978; 4refs
Conference held in Dearborn, Mich., 25-27 Sep 1978.
Availability: In HS-025 206

HS-025 225

APPLIED AUTOMOTIVE ELECTRONICS

A brief description of electronic subsystems available on current production automobiles is presented, with a discussion of the effects of the automotive environment on electronic components. Among the systems in which electronic components are involved are air cushion restraints, diagnostic circuitry, alternator rectifier and voltage regulator, climate control, electronic clocks, cruise control, digital displays, automatic door locks, electronic fuel injection, headlight and lamp timing control, electronic ignition, intrusion alarms, electronic spark timing, tachometers, wheel lock control systems, and windshield wipers. Included are an estimate of the number of electronic components used in each subsystem; a summary, in chart form, of the availability, frequency of installation, and consumer cost of electronic systems available on 1977 automobiles; and a list of the major barriers and developments required for the implementation of some proposed automotive electronic systems. Detailed charts and diagrams are included.

by Rosslyn J. Cannon; James C. Champlin; Joseph P. Ryan;
Katharine Rima Schnepf
Wayne State Univ.; General Motors Inst.; Purdue Univ.
Publ: HS-025 206 (SAE-P-76; IEEE-78CH1343-3VT),
"Convergence 78. International Conference on Automotive Electronics Proceedings," Warrendale, Pa., 1978 p131-63
Rept. No. SAE-780859; 1978; 42refs
Conference held in Dearborn, Mich., 25-27 Sep 1978.
Availability: In HS-025 206

HS-025 226

EMISSION CONTROL AT GM [GENERAL MOTORS]

General Motors has developed a computer controlled catalytic converter system, the C-4. Major system components include

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a catalytic converter, electro-mechanical carburetor, exhaust oxygen sensor, coolant temperature sensor and electronic control module. A diagram shows the location of these components in the 1979 closed loop system, and components are illustrated in separate diagrams and schematics. The system's primary function is to provide a precisely controlled air/fuel ratio to the catalytic converter for efficient reduction of regulated exhaust constituents. Functions being considered for the future include electronic spark timing, idle speed control, throttle body injection, programmed exhaust gas recirculation (EGR), choke and air control, evaporative emission purge system, a knock limiter, and transmission controls.

by R. J. Schultz
General Motors Corp., Emission Control Systems Proj. Center
Publ: HS-025 206 (SAE-P-76; IEEE-78CH1343-3VT),
"Convergence 78. International Conference on Automotive Electronics Proceedings," Warrendale, Pa., 1978 p164-9
Rept. No. SAE-780843; 1978
Conference held in Dearborn, Mich., 25-27 Sep 1978.
Availability: In HS-025 206

HS-025 227

DRIVER BEHAVIOR AT INTERSECTIONS WITH REGARD TO PRIORITY RULES AND ROAD DESIGN, AN EXPLORATORY STUDY (FORARBETEENDE I GATUKORSNINGAR I RELATION TILL FORETRADESREGLER OCH VAGUTFORMNING, EN EXPLORATIV STUDIE

Driver observance of priority rules at urban intersections was investigated preliminarily by an analysis of driver behavior at 40 intersections in Uppsala, Sweden, which varied according to geometry (three-way and four-way crossings), and when different priority rules (right-of-way rule, yield rule, and right-hand rule) were applicable. Behavioral variables studied at each intersection were the driver's maximum horizontal turning of the head, speed of vehicle, driver's verbal description of his driving behavior, and driver's knowledge of the legally-applicable priority rule. The test subjects were skilled in driving and familiar with the test area, but were not told the purpose of the study. Results from intersections at which the right-of-way and yield rules were applicable and marked (for the subjects when passing) show that all subjects were well-acquainted with and obeyed these rules. Results from the four-way intersections where the right-hand rule applied show that this rule was obeyed to a very limited extent (26%), and that half the subjects had a poor knowledge and the other half a satisfactory knowledge of the right-hand rule. For three-way intersections where the right-hand-rule was applicable and where the subjects drove on the straight-through road, the results show that the subjects drove as if they had the right-of-way. When the subjects drove on the side street, they all drove as if they should yield. The most surprising result of the study is that the subjects, irrespective of knowledge of the right-hand rule, did not obey this rule in at least 19 of a total of 23 intersections where this rule was applicable. Results suggest that the right-hand rule is poorly adjusted to normal driver behavior patterns and drivers show a well-adapted

behavior at intersections where one traffic stream has evident and marked priority over the other.

by Gabriel Helmers; Lars Aberg
Uppsala Universitet, Box 227, 751 04 Uppsala, Sweden
Rept. No. VTI-167; 1978; 70p 5refs
Translated from Swedish (original 42p; translation 28p).
Research sponsored by Transportforskningsdelegationen (Transportation Res. Delegation), Sweden.
Availability: Reference copy only

HS-025 228

AUTO REPAIRS: THE \$20 BILLION RIP-OFF. SPECIAL REPORT

Various Federal government and private sector evaluations are cited concerning the annual economic waste caused by improper or unnecessary auto repairs and maintenance in the U.S., estimated by the National Hwy. Traffic Safety Administration (NHTSA) to be \$20 billion. NHTSA attributes half of the loss to fraudulent, incompetent, or unnecessary repairs, and the remainder to automobile designs that place a priority on ease of manufacture over ease of repair and diagnosis and to owners' misunderstanding or ignoring their cars' maintenance and repair needs. It is stated that car owners could help protect themselves to some degree by educating themselves about cars, but that their failure to do so does not justify their victimization by repair servicemen. A typical newspaper survey, out of many similar ones, revealed that 13 out of 24 repair shops either completely misdiagnosed a problem with a specific car or recommended expensive and unnecessary work. Other cited surveys showed consumer dissatisfaction with auto repair service (34% of those questioned) and unnecessary repairs made to cars (25% of cars studied). It is pointed out that training programs for auto mechanics do not begin to meet the enormous need, although there are some excellent training programs. Although the problem of obtaining an adequate supply of honest and competent auto repair personnel remains a huge one, the few steps which have been taken (e.g. National Inst. for Automobile Service Excellence program to improve the quality of repair services; Automotive Consumer Action Panels developed by National Automobile Dealers Assoc.; Shell program designating qualifying service stations as Shell Auto Care stations and its public relations-advertising program; increase in the number of states with laws regulating auto repair practices) indicate that the problem is not insurmountable given the requisite will by legislators, consumer groups, and auto trade leaders. The auto industry is cited as giving low priority to ease and economy of repair of the vehicles it manufactures. It is also noted that within given classes of insured cars, there is substantial variation of property loss by car make, model, and year and that essentially the same models are good or bad from year to year. These facts have implications for insurance company policies (rates based on damageability, repairability), not to mention auto safety.

by Al Frantz; Bernard Kaapcke
Publ: Journal of Insurance v11 n1 p13-20 (Jan-Feb 1979)
1979; 3refs
Availability: See publication

CARS WITH BRAINS

The impetus for the rapid development of U.S. automotive electronics is the need for better fuel economy and reduced exhaust emissions, as well as driver convenience. Cadillac's Trip Commuter, a preprogrammed information center available on 1978 Seville models as a mid-year option, tells the driver the amount of remaining fuel, average and instantaneous mpg, average car speed, total elapsed trip time, driving range on remaining fuel supply, miles to predetermined destination, estimated arrival time, time of day, engine rpm, engine temperature, and system voltage. Chrysler was the first company (1978) to offer a computerized AM/FM stereo radio. The radio is controlled by a microprocessor which enables entry into the memory bank of as many as 10 stations which may be recalled later with the touch of a button; the radio automatically assures precise station tuning. The list of electronic systems under development includes every aspect of auto engineering, including safety. One device with long-range possibilities is an alcohol ignition interlock that would prevent alcohol-impaired drivers from starting a car. Radar sensors are being developed to actuate the brakes of a car which is on a collision course. The old gear shift lever may be replaced by a pushbutton system. Electronics may also replace the ignition key. Research is being conducted on a tamper-proof ignition and door lock system which uses a coded punch card inserted into slots in the doors and dash. The next major automotive option may be the telephone, as the result of a massive program launched by American Telephone and Telegraph Co. to develop a more economical system for car phones. Probably the ultimate in electronics is a special car developed by General Motors which has 12 pushbuttons in the middle of the steering wheel which control all the common electrical controls, such as turn signals, windshield washer-wipers, and cruise control.

by Ed Janicki

Publ: California Highway Patrolman v42 n11 p10-1, 48-9 (Jan 1979)
1979

Availability: See publication

HS-025 230

THE ECONOMICS OF ALCOHOLISM

The economic cost of alcoholism and alcohol abuse is analyzed (present annual cost in the U.S. conservatively estimated at \$30 billion). Since people may be less productive because of alcohol abuse, this means the economic values of their production will be at a lower level. Alcoholism can result in the diversion of resources into the production of goods and services required because of the various consequences of the problem. Individually analyzed are the following aspects of the economic cost of alcoholism: reduced productivity of workers, medical and health costs, traffic accidents, crime that is associated with alcohol, and social responses to the problem (e.g. research, treatment, prevention, and training programs in the field of alcoholism; unemployment, workmens' compensation and general poverty-related programs). Treatment and prevention of alcohol abuse are considered. Tables provide the following statistics on the economic consequences of alcoholism in the U.S.: percentage of households at various income levels in which there are and are not alcohol-abusing males; estimated cost of lost production in military due to alcohol abuse (1971), estimated lost production due to excess mortality

among male alcohol abusers, estimated cost of auto accidents attributable to alcohol abuse, estimated economic cost of violent crime in which alcohol was associated with the crime, and estimated cost of certain components of the social welfare system.

by Harvey L. Heaton

Publ: California Highway Patrolman v42 n11 p19, 78-81, 83 (Jan 1979)

1979; 15refs

Availability: See publication

HS-025 231

**RAILROAD/HIGHWAY ACCIDENT REPORT.
SEABOARD COAST LINE/AMTRAK PASSENGER
TRAIN/PICKUP TRUCK COLLISION, PLANT CITY,
FLORIDA, OCTOBER 2, 1977**

At 8:25 PM, EDT, on 2 Oct 1977, westbound Seaboard Coast Line/Amtrak passenger train No. 57 struck a northbound pickup truck at a grade crossing in Plant City, Florida. The collision occurred when the pickup truck proceeded past the railroad-crossing flashing signals onto the track and into the path of the train, which was traveling at 70 mph. The 10 occupants of the pickup truck were killed; neither the crew nor the 30 passengers of the train were injured. It was determined that the probable cause of the accident was the failure of the pickup truck driver, who was under the influence of alcohol, to stop short of the railroad tracks in response to the warnings of an approaching train and an activated railroad-crossing flashing signal. It is recommended that the Federal Hwy. Administration (FHWA), the Federal Railroad Administration, Amtrak, the Seaboard Coast Line Railroad Co., and the Florida Dept. of Transportation (DOT) cooperate to take necessary corrective action to reduce the high frequency of railroad/highway grade-crossing accidents along the 240 mi of track between Jacksonville and Tampa. It is recommended that the city of Plant City cooperate with the Florida DOT and the Seaboard Coast Line Railroad to bring about the installation of the recommended reflectorized, lighted, automatic gates and cantilever, flashing light signals and uniform signal timing devices at the Turkey Creek crossing in Plant City; install the required advance pavement markings on Turkey Creek Rd. on both approaches to grade crossing; relocate warning signs on Turkey Creek Rd. 250 ft before both approaches; and emphasize, as part of its Operation Lifesaver program, warnings to grade-crossing warning-signal violators and those who drive while under the influence of alcohol or drugs. It is recommended that the National Hwy. Traffic Safety Administration evaluate and report on those alcohol countermeasures found to be practical and effective for the reduction in number of alcohol-involved drivers. It is recommended that the State of Florida encourage state-level participation in and high-priority implementation of Operation Lifesaver railroad/highway grade crossing and selective law enforcement programs. It is recommended that the Florida DOT include provisions for uniform warning times for various train speeds in conformance with American Assoc. of Railroads and FHWA guidelines. It is recommended that Seaboard Coast Line Railroad cooperate with the city of Plant City to expedite installation of recommended gates and signals.

National Transportation Safety Board, Bureau of Accident Investigation, Washington, D.C. 20594
Rept. No. NTSB-RHR-78-2; 1978; 29p 20refs
Availability: NTIS

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ANTILOCK SYSTEMS FOR TRACTOR-SEMITRAILER COMBINATIONS, A SIMULATION COMPUTATION (ANORDNUNG VON BLOCKIERVERHINDERERN BEI SATTELKRAFTFAHRZEUGEN, EINE SIMULATIONSRECHNUNG)

The performances of eight configurations of antilock devices for tractor-semitrailer brake systems were investigated theoretically for the case of an emergency ("panic") braking situation for different driver maneuvers and different road conditions. Computer simulations were made using a three-dimensional model of a tractor-semitrailer combination (two-axle tractor and a trailer with a double-axle assembly); in this six-mass model (two body masses, four axle masses), both vehicles can move transitionally in the directions of the three main axes and can revolve around these axes. Although comparison of the antilock systems with respect to stopping distance, directional stability, and steerability showed significant differences, for most of the driving situations studied, the superiority of a truck with a suitable antilock system over a vehicle not so equipped was demonstrated. A system with individual wheel control with a modified tractor front axle, and a diagonal configuration of the sensors with paired wheel control exhibited favorable cost-benefit relationships.

by Reinhard Alweswerth
Publ: ATZ Automobiltechnische Zeitschrift v80 n5 p213-4, 217-20 (1978)
1978; 21p 2refs
Translated from German (original 6p; translation 15p). Part of dissertation, Hannover Technical Univ. (Germany).
Availability: Reference copy only

HS-025 233

EPIDEMIOLOGIC STUDY OF THE EFFECTS OF AUTOMOBILE TRAFFIC ON BLOOD LEAD LEVELS

An investigation was made of the absorption of lead by persons of different age-sex groups in the Dallas Metropolitan Area, in north-central Texas, who were exposed to automobile emissions of lead at traffic densities from less than 1000 cars per day to 25,000 cars per day. The relationships between traffic density and lead in various environmental samples (soil from participant residences, outdoor dust from selected sites in the study area, and air particulate matter from streets of different traffic densities where participants lived) were also examined. A house-to-house survey based on a strict set of selection criteria was used to recruit study participants. Anyone whose blood lead level was affected by exposure to sources of nonfood lead other than automobile emissions was eliminated. At each house a series of environmental measurements were taken which involved traffic volume, and household samples of tap water, interior and exterior paint, house dust, and window sill wipes. Two blood samples, a week apart, were taken from the participants. In the range of traffic exposures studied, no relationship with blood levels was observed (maximum mean lead less than 2.0 microg/cu m). A positive relationship between smoking and blood lead levels

was found for both males and females; this relationship was statistically significant for females but not for males.

by D. E. Johnson; R. J. Prevost; J. B. Tillery; K. T. Kimball; J. M. Hosenfeld
Southwest Res. Inst., 3600 Yoakum Blvd., Houston, Tex. 77006
EPA-68-02-2227
Rept. No. EPA-600/1-78-055; PB-285 826; 1978; 385p 39refs
Availability: NTIS

HS-025 234

OCTANE REQUIREMENT INCREASE OF 1975 MODEL CARS

A test program designed to study octane requirement increase (ORI) in cars restricted to the use of unleaded gasoline involved 175 cars from the 1975 model year, the first model year when there was widespread required use of unleaded gasoline. Measurements showed that octane requirements generally stabilized at odometer readings of between 16,000 and 20,000 mi. At the 90% satisfied level, about 85% of the stabilized ORI was achieved by 10,000 mi, and about 95% by 16,000 mi. Using unleaded full-boiling range reference fuels, at the 50% satisfied level, the average sales-weighted ORI after 16,000 mi was 5.6 RON (Research Octane Number) and 4.0 MON (Motor Octane Number), respectively. The comparable result at the 90% satisfied level was 6.7 RON and 4.7 MON, respectively. Octane requirement results for this ORI study at 8000 mi and 12,000 mi bracketed results obtained in a 1975 Octane Number Requirement Survey at satisfactory levels above 50%.

Coordinating Res. Council, Motor Road Test Group, 30 Rockefeller Plaza, New York, N.Y. 10020
Rept. No. CRC-498; 1978; 72p 4refs
Availability: Corporate author

HS-025 235

DRIVEABILITY PERFORMANCE OF 1977 PASSENGER CARS AT INTERMEDIATE AMBIENT TEMPERATURES--PASO ROBLES [CALIFORNIA]

Forty 1977 model year cars were tested with three fuels of different volatilities (low, intermediate, and high) in order to determine intermediate-temperature vehicle driveability. In one of three subprograms conducted, fifteen of the 40 cars were tested after a 2 1/2-hr or 3-hr soak to determine the severity of short soaks in comparison to overnight soaks. Another subprogram, designed to evaluate measurements by the Front-End Volatility Index (FEVI), was conducted with six 1973-1977 model year cars using a different set of fuels. The third subprogram, intended to serve as a pilot for an anticipated program, compared the driveability performance evaluated by people not familiar with driveability testing ("customer" drivers) with the driveability performance as determined by trained raters. The 1977 (mostly Federal) model cars showed considerably better driveability performance than the 1973 and 1975 California models tested in two previous programs. Four of the California cars had about 50% greater total weighted demerits (TWD) than Federal cars matched by make, model, and engine. Decreasing fuel volatility caused an increase in driveability problems. Average TWD with the 1977 model cars were 39, 67, and 126 for the high, average, and low volatility fuels, respectively. A limited investigation of soak time showed that after 2-hr or 3-hr soaks, the influence of fuel

volatility on driveability was significant. Driveability was generally better with short soaks than with overnight soaks. The effects on driveability of front-end volatility were evaluated with three fuels ranging from 19 FEVI to 13 FEVI. Varying FEVI had only a minor effect on driveability. Five "customer" drivers were able to distinguish among the three main program test fuels on the basis of volatility-related driveability problems. Their performance ratings indicated a high degree of annoyance with the least volatile fuel, but few problems with either of the other fuels.

Coordinating Res. Council, Motor Volatility Group, 30 Rockefeller Plaza, New York, N.Y. 10020
Rept. No. CRC-499; 1978; 90p 2refs
Availability: Corporate author

HS-025 236

DEATHS AND INJURIES ON NIGERIAN ROADS: A STUDY OF 1590 CASUALTIES

A total of 1590 road traffic accident casualties in Nigeria (451 pedestrians, 71 bicyclists, 358 motorcyclists, and 710 motor vehicle occupants, including taxis, passenger cars, trucks, and buses) were studied in order to determine the degree of risk of the various road users in terms of fatal, serious, or minor accidents. It was found that pedestrians had the highest percentage of fatal accidents (25.9%), followed by motor vehicle occupants (19.4%), motorcyclists (18.2%), and bicyclists (12.7%). For every four pedestrian casualties, there was one fatality; the approximate injury/fatality proportions for vehicle occupants, motorcyclists, and bicyclists were 1 in 5, 1 in 6, and 1 in 8, respectively. It was also determined that rear seat passengers sustained half as many fatalities and a third as many injuries (both serious and minor) as front seat occupants, and that drivers had fewer fatalities but more injuries. Motorcycle drivers sustained less than a third the fatalities and injuries sustained by pillion passengers. The introduction of well-tested countermeasures is advocated to reduce morbidity and mortality among the different classes of road users in Nigeria. Such countermeasures include separation of vehicular and pedestrian traffic, proper use of well-designed motorcycle helmets, use of safety belts, safe vehicle designs (e.g. antiburst door latches, laminated windshields, strong passenger compartments, padded steering wheels, correctly-positioned head restraints), prohibition of passengers in open parts of trucks, and use of crash helmets by bicyclists. Whatever countermeasures are adopted, it is emphasized that legislation and enforcement coupled with education are needed for success.

by S. E. Asogwa
Publ: Journal of Traffic Medicine v6 n4 p52-4 (1978)
1978; 36refs
Sponsored by Nigeria Medical Res. Council.
Availability: See publication

HS-025 237

TRUCKERS' GUIDE TO SURVIVING WINTER

Advice is presented to the commercial truck driver on how to be comfortable and safe when driving or stranded during the winter season. Guidelines suggest proper clothing for warmth and comfort; recommendations are made for hats, boots, gloves, and layering of clothing (e.g. open-net underwear, double-lined cotton longjohns, wool pants, wool shirt, insulated vest, wool outer jacket), and where to shop for suitable ap-

parel. Information is given for selecting a good quality sleeping bag, a prime factor in keeping warm in a sleeper berth. Some basic rules are outlined for survival when stranded in the snow for several days. It is emphasized that a driver stay in his rig unless he can walk to an inhabited building in sight; the main concern is to stay warm, dry, and relaxed. Survival kits (containing such items as matches, aluminum foil, cans of sterno, long-burning candles, 5 or 10 bouillon cubes, small packs of honey) and signal kits (containing such items as a signal mirror, a loud whistle, red smoke flares, aerial flares, flashlights, and plug-in spotlight) are items necessary for survival in the event of being stuck in a snowstorm. Proper equipment and being prepared for emergencies are deemed the keys to surviving winter driving. A wind chill chart is included which indicates the wind speed/temperature ranges for human safety in terms of exposure: little danger (for properly clothed person), increasing danger (danger of exposed flesh freezing), and great danger.

by Brian Taylor
Publ: Owner Operator v9 n1 p26-30 (Jan-Feb 1979)
1979; 2refs
Availability: See publication

HS-025 238

HUMAN FACTORS SOCIETY ANNUAL MEETING (22ND) PROCEEDINGS. DETROIT, MICHIGAN, OCTOBER 16-19, 1978

Papers and abstracts (186) are presented on the application of human factors theory, covering ergonomics in industry, performance evaluation and workload, visual performance in driving, and display codes and dimensions. Other topics include training (systems, media, and methodology), operator performance in driving, safety in high risk environments, training and simulators, communication and computers, visual performance in aviation, and women at work. Current issues in the design of training and evaluation systems are presented, as are driver performance criterion development, visual performance, and human factors in manual materials handling. Other topics include human factors with ubiquitous payoff (training and instructions for new telephone systems), product design and the consumer, cognitive and motor performance, and visual displays and performance. Impact of human factors on developing effective organizations is addressed, as well as human factors standards impact on equipment design, and the human factors approach to energy conservation and technology. Anthropometry and design, system design and methodology, performance and stress, and safety on wheels are also covered. Other topics include human factors applied to meeting the needs of older and/or handicapped persons, impaired driver performance, and safety on foot. Also considered are experimental design (extension of the two level factorial problem), anatomical measurements of civilian populations, transportation and environmental safety, and product liability/product safety. Final sections cover environmental design in the micro-environment, and software considerations in computer systems.

by Edith J. Baise, ed.; James M. Miller, ed.
Human Factors Society, Inc., P.O. Box 1369, Santa Monica, Calif. 90406
1978; 730p refs
Includes HS-025 239--HS-025 263.
Availability: Corporate author \$15 to members, \$20 to non-members

HS-025 239

EFFECT OF HEADLIGHT ILLUMINATION ON DRIVER BEHAVIOR

The effect of different headlight patterns on driving performance was investigated during test drives along an 8-km rural highway. Eighteen subjects drove the test course once for each of three headlight conditions: low beam, high beam, and low-plus-high beam. Continuous recordings were obtained of vehicle speed, brake pressure, acceleration, steering wheel angle, and lane position. Response profiles for average and one standard deviation of response were plotted as a function of distance along the test course. Analysis of variance showed small but statistically significant illumination effects for average speed, average lane position, and standard deviation of steering wheel position and fore-aft accelerations. It was concluded that the test course may have been too difficult and thus may have limited effects of illumination conditions on the driving performance measures obtained in this first phase of testing.

by Martin Helander; John O. Merritt; Charles Abrams
Human Factors Res., Inc., Goleta, Calif.

DOT-HS-7-01724

Publ: HS-025 238, "Human Factors Society Annual Meeting (22nd) Proceedings," Santa Monica, Calif., 1978 p51-5 1978; 10refs

Meeting held in Detroit, Mich., 16-19 Oct 1978.

Availability: In HS-025 238

HS-025 240

HEADLIGHT GLARE RESISTANCE AND DRIVER AGE

The physiological glare thresholds (defined as the logarithm of the ratio at threshold between illuminances of glare source and target background) of 148 subjects from 5 to 91 years of age were measured in a Wolf glare tester. The data can be represented by a power function for physiological glare threshold. When tested in a realistic driving simulator, the headlight glare resistance (defined as the logarithm of the ratio of mean "acceptable" glare illuminance to fixed ambient illuminance) of 30 of these subjects were also found to decline with age. These results are discussed in terms of a hypothesis that headlight glare resistance equals physiological glare threshold plus subjective glare tolerance. All these functions have large interpersonal variation. Field measurements are provided on relevant glare ratios in typical night driving situations. Suggested countermeasures for headlight glare include polarized headlights, highway glare screens, road delineation, highway lighting, and driving restriction.

by Nathaniel H. Pulling; Ernst Wolf; Samuel P. Sturgis;
Donald R. Vaillancourt; James J. Dolliver
Liberty Mutual Res. Center, Hopkinton, Mass.; Eye Res.
Inst. of Retina Foundation, Boston, Mass.

Publ: HS-025 238, "Human Factors Society Annual Meeting (22nd) Proceedings," Santa Monica, Calif., 1978 p59-63 1978; 22refs

Meeting held in Detroit, Mich., 16-19 Oct 1978.

Availability: In HS-025 238

HS-025 241

THE ROLE OF VEHICLE CHARACTERISTICS IN DRIVERS' PERCEPTION OF AUTOMOBILE VELOCITY

Velocity production in the absence of speedometer information was investigated as a function of car size. In a first experiment, three vehicles of different size were supplied by the experimenters; in a second, a different sample of drivers used their own vehicles. In both experiments, subjects performed under normal and auditory attenuated conditions. Results indicated greater velocity production accuracy in small cars than in large ones and a tendency for drivers of small cars to make greater use of auditory information.

by Michael L. Matthews; Lawrence R. Cousins
University of Guelph, Guelph, Ont., Canada

Publ: HS-025 238, "Human Factors Society Annual Meeting (22nd) Proceedings," Santa Monica, Calif., 1978 p110-4 1978; 10refs

Meeting held in Detroit, Mich., 16-19 Oct 1978.

Availability: In HS-025 238

HS-025 242

SYSTEM ANALYSIS OF THE GENERAL DETERRENCE OF DRIVING WHILE INTOXICATED

A system analysis was completed of the general deterrence of driving while intoxicated (DWI). The analysis identified system elements relevant to the DWI decision and assessed the potential of countermeasures that might be employed in general deterrence programs. The DWI general deterrence framework is defined, the analytical methods are described, and the conclusions and recommendations derived from project results are presented. Also presented is a system model for interrelating factors which influence DWI deterrence and an associated computer-based simulation program for examining DWI deterrence alternatives. It is concluded that reduction in DWI depends upon general deterrence methods, and upon drivers' perceived risk and risk aversion characteristics. Relatively small changes in perceived risk may produce large changes in DWI or related accidents. Word-of-mouth feedback is not considered a deterrent to DWI. Increased enforcement is effective only when combined with increased information feedback about the consequences of enforcement. Widespread dissemination of this information has the greatest potential for reducing DWI trips and related accidents.

by Leland G. Summers; Douglas H. Harris
Anacapa Sciences, Inc., Santa Barbara, Calif.
DOT-HS-6-01456

Publ: HS-025 238, "Human Factors Society Annual Meeting (22nd) Proceedings," Santa Monica, Calif., 1978 p117-22 1978; 15refs

Meeting held in Detroit, Mich., 16-19 Oct 1978.

Availability: In HS-025 238

HS-025 243

A RELIABLE CRITERION FOR RELATIVELY SMALL GROUP DRIVER PERFORMANCE STUDIES

The Driver Performance Measurement method (DP14) was developed on a systems and content validity basis. The method must be used by specially trained observers/raters. Rather than a checklist, a "test instrument" for mass testing,

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or an accident predictor, the DPM is a highly reliable, immediate criterion or "yardstick" for research on limited size groups of subjects to develop and evaluate shorter test procedures for such applications as driver licensing and driver education. Content validity of the DPM procedure was developed using reiterative observation, task analysis, description and discussion of driver behavior sequences by three consecutive groups of people experienced in phases of driving behavior and driver education. Statistical reliability was determined by means of parallel observations by three groups of trained observer/raters on three groups of high school and college age drivers for a total of 122 subjects. The original DPM method showed very high reliability both between raters and within rater.

by T. W. Forbes
Michigan State Univ., Dept. of Psychology and Hwy. Traffic Safety Center, East Lansing, Mich.
Publ: HS-025 238, "Human Factors Society Annual Meeting (22nd) Proceedings," Santa Monica, Calif., 1978 p272-5
1978; 6refs
Meeting held in Detroit, Mich., 16-19 Oct 1978.
Availability: In HS-025 238

HS-025 244

COMMONPLACE HUMAN FACTORS PROBLEMS EXPERIENCED BY THE COLORBLIND--A PILOT QUESTIONNAIRE SURVEY

A pilot questionnaire survey was undertaken to test a proposed methodology for learning about and cataloguing the human factors problems experienced by color deficient individuals in dealing with the natural and man-made worlds. A comprehensive 7-page questionnaire was designed on the basis of extensive interviews with three persons having anomalous trichromacy (who see all colors but mismatch them, especially under dim light). The questionnaire was sent to 12 persons known to be colorblind; six replies were received. Problem areas identified included aesthetics (color coordination), physical problems (detecting sunburn or rashes), food (judgment of ripeness), recreation (identifying sports teams), occupational (certain vocations prohibited), use of tools, appliances, and other equipment (color coding), and transportation (traffic signals). Part of the questionnaire is appended.

by Edmond W. Israelski
Stevens Inst. of Tech., Hoboken, N.J.; American Telephone and Telegraph Co., Basking Ridge, N.J.
Publ: HS-025 238, "Human Factors Society Annual Meeting (22nd) Proceedings," Santa Monica, Calif., 1978 p347-51
1978; 16refs
Meeting held in Detroit, Mich., 16-19 Oct 1978.
Availability: In HS-025 238

HS-025 245

MALE-FEMALE DIFFERENCES IN VARIABLES AFFECTING PERFORMANCE

Literature was reviewed concerning variables affecting performance levels of males and females. Emphasis was placed on literature using both males and females as subjects in the areas of anthropometric, biomechanical, and physiological variables. When literature of this type was not available, comparable studies were considered for possible use. The results of this review indicate that there are sex differences in anthropometry with regard to body dimensions. In

biomechanics, sex differences were noted in reach envelopes, strength, and flexibility. Physiological differences were noted in responses to heat/cold stress and altitude. These differences were then applied to a performance matrix under the categories of sensory, process and control. Differences noted were either very specific or did not exist at all. This is due in part to a lack of research involving variables as they actually affect performance levels between males and females.

by Connie Grasley; M. M. Ayoub; Nancy J. Bethea
Texas Tech Univ., Dept. of Industrial Engineering, Lubbock, Tex.
Publ: HS-025 238, "Human Factors Society Annual Meeting (22nd) Proceedings," Santa Monica, Calif., 1978 p416-20
1978; 37refs
Meeting held in Detroit, Mich., 16-19 Oct 1978.
Availability: In HS-025 238

HS-025 246

DRIVER BEHAVIOR EFFECTS ON FUEL CONSUMPTION IN URBAN DRIVING

Data are examined from two published experimental studies in which drivers were instructed to drive other than normally, with the traffic: for example, to minimize fuel consumption or to minimize trip time. It is found that, in general, for each 1% increase (decrease) in trip time compared to driving normally with the traffic, the fuel consumption increases (decreases) by about 1.1%. However, expert drivers can save fuel without increasing trip time by skillfully adjusting their speed to avoid stops at traffic signals. It is shown that the formal problem to be solved to minimize fuel consumption on an urban trip is so complicated that even a "perfect" fuel economy meter would not enable a driver to achieve this minimum.

by Leonard Evans
General Motors Res. Labs., Warren, Mich.
Publ: HS-025 238, "Human Factors Society Annual Meeting (22nd) Proceedings," Santa Monica, Calif., 1978 p437-42
1978; 17refs
Meeting held in Detroit, Mich., 16-19 Oct 1978.
Availability: In HS-025 238

HS-025 247

ESTIMATING PERCENTILES OF NONNORMAL ANTHROPOMETRIC POPULATIONS. FINAL REPORT

In addressing the question of how to estimate percentiles of nonnormal populations, a nonparametric percentile estimation method, based on the use of a kernel-type probability density function estimator, is presented. (A "nonparametric" method is defined as a method that does not make or require any assumption about the statistical distribution of the underlying population.) Although the method is simple to use, a single nonlinear equation must be numerically solved on a computer by any one of numerous well-documented nonlinear root finding methods. Two examples are used to illustrate the method. Fifty selected samples of hip breadth data are randomly drawn from a population of 2420 from the 1967 anthropometric survey of U.S. Air Force flying personnel. The proposed method is compared to the standard gaussian method. Since this population was selected as normally distributed, the standard method outperforms the proposed nonparametric method. In the case of grip-strength data, the proposed method yields more accurate estimates, in a mean squared error sense, of the

upper percentiles of this population. For anthropometric distributions known to be nonnormal or where normality cannot be assumed, the proposed nonparametric method appears to be a method for consideration.

by H. F. Martz, Jr.
Los Alamos Scientific Lab., Los Alamos, N. Mex. 87544
Publ: HS-025 238, "Human Factors Society Annual Meeting (22nd) Proceedings," Santa Monica, Calif., 1978 p445-9
1978; 8refs
Meeting held in Detroit, Mich., 16-19 Oct 1978.
Availability: In HS-025 238

HS-025 248

ANTHROPOMETRY OF WOMEN OF THE U.S. ARMY

A new anthropometric survey of U.S. Army women was planned and carried out in 1976-1977 in response to the need for current and comprehensive body size data for the women who make up an increasingly large part of the United States Army. As a result, new anthropometric data now are available for Army women, as well as workspace and strength measurements. While there has been relatively little change in the body dimensions of Army women between 1946 and 1977, comparisons of data for men and women clearly show that serious design and sizing problems will be encountered in the development of clothing and equipment intended for use by both Army men and women.

by Robert M. White
U.S. Army Natick Res. and Devel. Command, Natick, Mass.
Publ: HS-025 238, "Human Factors Society Annual Meeting (22nd) Proceedings," Santa Monica, Calif., 1978 p456-61
1978; 19refs
Meeting held in Detroit, Mich., 16-19 Oct 1978.
Availability: In HS-025 238

HS-025 249

HUMAN PERFORMANCE VARIABILITY IN ACCIDENT CAUSATION

Some choice reaction time data are examined in terms of variability as related to skill, work session length, alcohol stress, sleep deprivation and compatibility. Analytic distributions are examined as to their possible applicability and properties of their "far right tails." Human performance variability is the appropriate measure for including human limitations in accident causation models. Before substantive progress can be made, three issues must be attacked. Experiments must include more appropriate arrays of independent variables, especially commonly found incompatibilities, stressors, and environments. Experiments must be run in ways more closely simulating industrial, home, or highway conditions reflecting realistic instructions, ambiguities, conflicting reward structures and realistic motivations. Measures in these experiments must reflect variability--the "far right tail" in the reaction time data. There is a need for research on appropriate statistical and

analytic descriptors and performance models specific to these events.

by Gordon H. Robinson; Thomas R. Jacobson
University of Wisconsin, Madison, Wis.
Publ: HS-025 238, "Human Factors Society Annual Meeting (22nd) Proceedings," Santa Monica, Calif., 1978 p517-21
1978; 26refs
Meeting held in Detroit, Mich., 16-19 Oct 1978. Supported by Wisconsin Alumni Res. Foundation.
Availability: In HS-025 238

HS-025 250

A STUDY OF POST-CRASH BUS EVACUATION PROBLEMS

A study was conducted to provide information related to the post-crash evacuation of intercity buses. A review of bus accident data and relevant literature was completed to provide an understanding of the variables related to bus evacuation. A survey was completed to document the passenger characteristics of a typical bus load. A special data base was analyzed for injuries resulting from falls or jumps of eight feet or less. A study was then designed and conducted to investigate bus evacuation under several "worst-case" conditions, and 16 mm movie films were made of each evacuation. An analysis of the study provided information on time to evacuate for various conditions, hazards in evacuation, subjects reaction to the evacuation tests and implications for bus design and operation to minimize evacuation problems. Among the variables encountered in bus crashes are turnovers (turnovers on the right side more hazardous due to exit door blockage), illumination (night crashes more difficult for escaping), injuries (impeding escape), post-crash hazards (trampling), and escape routes (i.e. front windshield, overhead hatch).

by Jerry L. Purswell; Alan L. Dorris
University of Oklahoma, Norman, Okla.
Publ: HS-025 238, "Human Factors Society Annual Meeting (22nd) Proceedings," Santa Monica, Calif., 1978 p522-7
1978; 3refs
Meeting held in Detroit, Mich., 16-19 Oct 1978.
Availability: In HS-025 238

HS-025 251

PASSIVE SEAT BELT DESIGN AND STANDARDS

The problem of ensuring that passive seat belt systems are acceptable to most automobile users is complicated by the fact that these systems cannot be optimized geometrically as easily as active systems. The difficulty in regulating design of passive belts for maximum comfort is that minimum performance standards, not specifications, are the purview of the regulatory agency. Five general concepts in passive belt design were investigated for the possibility of minimizing discomfort, inconvenience, and/or confusion (cited diagrams missing). Optimization was attempted by meeting previous belt geometry features, by providing minimum belt tension commensurate with adequate webbing retractability, and properly locating a manual "convenience hook" and an emergency release buckle.

Tentative rulemaking objectives are suggested, covering ingress, operation, and egress requirements.

by Wesley E. Woodson; Thomas L. Black

Man Factors, Inc.

Publ: HS-025 238, "Human Factors Society Annual Meeting (22nd) Proceedings," Santa Monica, Calif., 1978 p528-31 1978; 2refs

Meeting held in Detroit, Mich., 16-19 Oct 1978.

Availability: In HS-025 238

HS-025 252

DRIVER PERFORMANCE AND FUEL ECONOMY

Ninety drivers drove a city route under closely controlled conditions. Driver behaviors were scored and the vehicle was instrumented to record variables relevant to fuel economy. Fuel economy was related largely to average speed and number of variations in speed. Of the driver performance variables, only following distance related to fuel economy. Leaving adequate headway is a strategy that should result in both a saving in fuel and greater safety. Greater fuel savings may be possible based on choice of route and time than on any adjustments to traffic.

by Margaret Hubbard Jones; Michael R. Appleby
University of Southern California, Traffic Safety Center;
Automobile Club of Southern California

Publ: HS-025 238, "Human Factors Society Annual Meeting (22nd) Proceedings," Santa Monica, Calif., 1978 p539-40 1978; 6refs

Meeting held in Detroit, Mich., 16-19 Oct 1978.

Availability: In HS-025 238

HS-025 253

REVIEW OF EFFECTS OF ALCOHOL AND OTHER LICIT DRUGS ON DRIVING-RELATED PERFORMANCE

A review is presented of the effects of alcohol and licit drugs on performance related to driving. About 20% of persons of driving age use some licit drug, while a much greater percentage drink alcohol. Alcohol is used in combination with another licit drug by about 10% of persons of driving age. Alcohol is associated with about 50% of fatal traffic accidents, 30% of injury accidents and 10% of non-injury accidents. Other licit drugs, such as diazepam, are involved in about 20% of non-fatal accidents. Alcohol combined with other licit drugs, such as diazepam, is involved in about 10% of injury accidents. It is difficult to establish that crash risk is increased by the use of psychoactive drugs because of quantitative and qualitative differences in drug effects, differences in duration of effect, wide variety of available drugs, possible cumulative and/or interaction effects between drugs and alcohol, and individual differences in reaction to drugs. Studies of the effects of tranquilizers on human performance present conflicting results. A general consensus of opinion is that alcohol in interaction with sedatives and/or tranquilizers results in an additive or in some cases a synergistic effect. As with tranquilizers, moderate use of stimulants (i.e. amphetamines) may be partly beneficial, but prolonged or excessive use may increase driving hazards. Most impairment caused by barbiturates apparently occurs during the initial stages of use, with relatively little decrement of performance during chronic use (as by epileptics). Studies show a synergistic effect between barbiturates and alcohol. Antihistamines, such as diphenhydramine

HC1 (Benadryl) may cause some decrements in human performance, an effect enhanced when accompanied by a moderate dose of alcohol. Most of the studies reviewed have been conducted in laboratory settings; very few studies have measured on-the-road performance or action in situations requiring complex decision-making and skill.

by Peter A. Howat; Rudolf G. Mortimer

University of Illinois, Champaign, Ill.

Publ: HS-025 238, "Human Factors Society Annual Meeting (22nd) Proceedings," Santa Monica, Calif., 1978 p564-72 1978; 79refs

Meeting held in Detroit, Mich., 16-19 Oct 1978.

Availability: In HS-025 238

HS-025 254

CHANGES IN DRIVER STEERING CONTROL WITH LEARNING

A hierarchy of strategies were postulated to describe the process of learning steering control. The basic mathematical model used to describe the driver as controller was the crossover model, which was developed from laboratory experiments using compensatory tracking tasks. Vehicle motion and steering control data were recorded for twelve novices who drove an instrumented car twice a week during and after a driver training course. Driver describing functions were calculated. The data suggested that the largest changes in steering control with learning were in the way the driver used the lateral position cue.

by Alison Smiley; Lloyd Reid; Morris Fraser

Southern California Res. Inst., Los Angeles, Calif.; University of Toronto, Ont., Canada; University of Waterloo, Ont., Canada

Publ: HS-025 238, "Human Factors Society Annual Meeting (22nd) Proceedings," Santa Monica, Calif., 1978 p574-8 1978; 6refs

Meeting held in Detroit, Mich., 16-19 Oct 1978.

Availability: In HS-025 238

HS-025 255

ALCOHOL EFFECTS ON DRIVER RISK TAKING

Selected results are reviewed from past driving simulator studies. The driving tasks include steering regulation against wind/road disturbances, speed control on curves, and decision making in a signal light situation. A common alcohol impairment mechanism is found in each of these situations, namely increased driver variability. The driver's risk exposure also increases with alcohol impairment and is extremely sensitive to performance variability changes. It is hypothesized that drivers are not generally aware of risk exposure, even under alcohol-impaired conditions. Countermeasure approaches to driver impairment are also discussed. It is suggested that highway and traffic engineers compensate for the intoxicated driver's increased variability by improving intersection design, signal timing, lane delineation, and signing, particularly for curve advisory speeds. Other suggested countermeasures are public information and driver education/training, including dissemination of information on the inexorable but subtle effects of al-

September 28, 1979

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cohol impairment on driver inconsistency of performance and perception, and the consequent increase in risk exposure.

by R. Wade Allen; Stephen H. Schwartz
Systems Technology, Inc., Hawthorne, Calif.
Publ: HS-025 238, "Human Factors Society Annual Meeting (22nd) Proceedings," Santa Monica, Calif., 1978 p579-82
1978; 12refs
Meeting held in Detroit, Mich., 16-19 Oct 1978.
Availability: In HS-025 238

HS-025 256

ANTHROPOMETRIC CONSIDERATIONS IN HUMAN IMPACT TOLERANCE RESEARCH

Since standard anthropometric procedures are inadequate to the task of specifying joint mobility and resistance to force, and no common procedures or lists of useful measurements are available for cadaver or laboratory animal subjects, there are major shortcomings in the current designs of crash test dummies and the parallel input data sets required for the operation of computerized mathematical crash victim simulations. The problems and the activities being carried out for their resolution are briefly reviewed here. Four typical lists of body measurements are described (ISO, SAE J963, and two by HSRI), and compared with a parameter list for input to mathematical crash victim simulators (i.e. MVMA 2-D and Calspan 3-D computer programs). The following activities are recommended to address issues not currently resolved: development and acceptance of a core list of anthropometric measurements for comparison of human populations and as an aid to resolution of problems with data contained in existing body measurement lists; improvement of the biomechanics data base with respect to human body linkage descriptors, models of joints, and the force-deformation characteristics of the human body; and development of improved body measurement lists for use by researchers using cadaver and laboratory animal test subjects.

by D. H. Robbins
University of Michigan, Hwy. Safety Res. Inst., Ann Arbor, Mich.
Publ: HS-025 238, "Human Factors Society Annual Meeting (22nd) Proceedings," Santa Monica, Calif., 1978 p611-5
1978; 6refs
Meeting held in Detroit, Mich., 16-19 Oct 1978.
Availability: In HS-025 238

HS-025 257

REPEAL AND MODIFICATION OF MANDATORY MOTORCYCLE HELMET LEGISLATION

From a review of the literature, it has been determined that motorcycle helmet usage reduces the probability of being seriously injured or killed in a motorcycle accident. Enactment of the helmet laws has been associated with reduced accident severity in many states, including Virginia. It has been shown that helmet usage does not impair hearing or vision, does not encourage risktaking, and does not increase the probability of incurring a neck injury as the result of a motorcycle crash. Thus, requiring the use of motorcycle helmets is a logical, reasonable, and effective method for improving motorcycle safety. Additionally, the helmet laws have been ruled constitutional in the courts of last resort in 27 states, with such cases being introduced in the U.S. Supreme Court five times. These cases establish that the helmet laws do not constitute a viola-

tion of the first amendment right of free speech, the right of due process, or the right of equal protection. Also, these laws appear to have public support in many states among both motorcyclists and nonmotorcyclists.

by Cheryl W. Lynn
Virginia Hwy. and Transportation Res. Council,
Charlottesville, Va.
Publ: HS-025 238, "Human Factors Society Annual Meeting (22nd) Proceedings," Santa Monica, Calif., 1978 p620-4
1978; 31refs
Meeting held in Detroit, Mich., 16-19 Oct 1978.
Availability: In HS-025 238

HS-025 258

SIMULATION OF HIGHWAY ACCIDENTS

Based on a new motivational model of driving and/or pedestrian behavior, a technique has been developed for simulating highway accidents to include both the favorable consequences of completing a trip without an accident and the unfavorable consequences (including injury and pain) of having one. Thereby trip-making, accident-avoidance behavior, and risk-taking behavior can be brought into the laboratory for experimental examination of variables that might make accidents less likely. The motivational model of driving behavior is derived from principles of behavioral psychology, especially operant conditioning. The behavioral model explains people's actions in terms of a four way contingency encompassing human responses (units of observable behavior), consequences of responses, potentiators of responses, and discriminative stimuli (cues) for responses. In the driving or walking situation, there are potentiator variables: destination, escape, compensation, situation, and avoidance driving (walking). Accident simulation methods at the Inst. for Behavioral Research are described, including such factors as the driver (or pedestrian), vehicle, vehicle control, highway environment, trip movement, hazard situation, warning indicator, accident, and accident effects. Avoidance conditioning is produced by an accident effects simulator called a "cold pressor", which puts the subject's hand into a container of ice water when a simulated accident occurs. Monetary rewards were considered for successful accident avoidance.

by H. McIlvaine Parsons
Institute for Behavioral Res., Inc., Silver Spring, Md.
Publ: HS-025 238, "Human Factors Society Annual Meeting (22nd) Proceedings," Santa Monica, Calif., 1978 p625-30
1978; 25refs
Meeting held in Detroit, Mich., 16-19 Oct 1978.
Availability: In HS-025 238

HS-025 259

MOPEDS AND MOPED LEGISLATION

The basic issue concerning mopeds is whether they should be considered as bicycles - and be basically free of regulation, or as motorcycles - and thus be subject to all regulations applicable to motor vehicles. In an effort to resolve this issue, European accident data, Virginia crash data, and the laws of the several states were reviewed. In terms of crash, injury, and fatality data, mopeds are more like motorcycles than bicycles. The laws of the various states lack a uniform approach in dealing with mopeds as a form of transportation. There is little agreement on the specific areas in which there is a need for regulation and how comprehensive this regulation should be.

From the review made for this study, it was recommended that a separate category of vehicles be established for mopeds, as they are neither bicycles or motorcycles. It was further recommended that the vehicles be registered, that their operators be licensed, that maximum allowable speed and horsepower be 30 mph and 1.5 bhp, and that liability insurance be made available for purchase by moped owners. Vehicle inspection is not considered warranted, and there are insufficient data to determine whether helmet and eye protection should be mandatory, although one study indicated that while mopeds are less likely to be involved in a crash, the risk of injury in a crash is identical to that of motorcycles. Human factors implications for mopeds include driver training, and such traffic engineering considerations as roadway widths, placement of storm sewer grates, signalization, speed limits, and surface conditions. Considerations for vehicle design include emission controls, speed and horsepower, visible signals, lights, and handling and maneuverability.

by Charles B. Stoke
Virginia Hwy. and Transportation Res. Council,
Charlottesville, Va.
Publ: HS-025 238, "Human Factors Society Annual Meeting
(22nd), Proceedings," Santa Monica, Calif., 1978 p636-9
1978
Meeting held in Detroit, Mich., 16-19 Oct 1978.
Availability: In HS-025 238

HS-025 260

THE USE OF THE FATAL ACCIDENT REPORTING SYSTEM (FARS) IN EVALUATING CHARACTERISTICS OF VIRGINIA TRAFFIC FATALITIES

Highway safety studies involving a review of accident reports often encounter problems resulting from incomplete information, contradictions in the available data, and difficulties in compiling information from various sources. For these reasons, the Fatal Accident Reporting System (FARS), a computerized data base, was chosen for use in evaluating the characteristics of Virginia traffic fatalities. The FARS was applied to investigate the reason for the increase in traffic fatalities in Virginia in 1977 and to determine fatality characteristics. Using data from the FARS, fatal traffic accidents in Virginia during 1976 and 1977 were compared by examining demographic characteristics of the accidents such as day of week, type of road, kind of location, and the age and sex of the drivers involved. The data were examined according to three categories: accident, vehicle/driver, and person. It was found, however, that for all levels of factors, some data were unusable because of problems in format, insufficient information, and apparent inconsistencies in coding. The system was not found to be easily accessible and was also comparatively expensive. For these reasons, it was concluded that use of the FARS does not appear to be the best method of evaluating characteristics of Virginia traffic fatalities.

by Deborah Mitchell; Cheryl Lynn
Virginia Hwy. and Transportation Res. Council,
Charlottesville, Va.
Publ: HS-025 238, "Human Factors Society Annual Meeting
(22nd) Proceedings," Santa Monica, Calif., 1978 p640-3
1978; 2refs
Meeting held in Detroit, Mich., 16-19 Oct 1978.
Availability: In HS-025 238

HS-025 261

REACH PROFILES FOR MALES AND FEMALES UNDER RESTRAINED AND UNRESTRAINED CONDITIONS

Reach envelope data are presented, based on samples of 25 males and 24 females between 18 and 42 years and 18 to 22 years of age respectively. These data which were obtained using a new technique involving the Ayoub Reach Anthropometer, compared well with other data collected using the Frankenstein type apparatus. The new technique makes it possible to collect static or dynamic reach data electronically through the use of a mini-computer. The apparatus and procedure are described and illustrated. This paper presents reach envelope data under restrained and unrestrained conditions and discusses the differences between male and female reach envelopes under both conditions.

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Texas Tech Univ., Dept. of Industrial Engineering, Lubbock,
Tex.
Publ: HS-025 238, "Human Factors Society Annual Meeting
(22nd) Proceedings," Santa Monica, Calif., 1978 p671-5
1978; 11refs
Meeting held in Detroit, Mich., 16-19 Oct 1978.
Availability: In HS-025 238

HS-025 262

ANATOMICAL COORDINATE SYSTEMS FOR HUMAN BODY SEGMENTS

An anatomically based coordinate system is a useful tool for standardizing the placement of instrumentation on segments of the human body or human surrogate. It is suggested that this system be based upon a fixed set of anatomical landmarks that are easily located by palpation and/or x-ray. A set of coordinate systems for the head, torso and extremities is proposed. Such systems will aid investigators in comparing data acquired at different laboratories involved in impact injury research. These systems can also be used for accurately locating the center of gravity of a body segment and for describing body motion in an impact environment.

by Arvind J. Padgaonkar; Shirley M. Lawson; Albert I. King
Wayne State Univ., Detroit, Mich.
DOT-HS-146-3-711
Publ: HS-025 238, "Human Factors Society Annual Meeting
(22nd) Proceedings," Santa Monica, Calif., 1978 p676-9
1978; 4refs
Meeting held in Detroit, Mich., 16-19 Oct 1978.
Availability: In HS-025 238

HS-025 263

FUNCTIONAL ANTHROPOMETRY

An urgent need in Ergonomics/Human Factors exists for anthropometric (including biomechanical) information which cannot be gleaned from the information traditionally provided by anthropologists and physiologists. The data must be relevant to today's and tomorrow's living and working conditions, and it must be suitable for engineering application. The needed information concerns dimensions of the human body, and functional strength and performance capabilities. It must pertain to dynamic conditions. Concepts and techniques must be developed and standardized which describe body positions and

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movements occurring in actual work, that translate traditional anthropometric data into functional information, and which establish formal interfaces ("reference points") between the human body and the equipment. New sampling strategies and advanced measuring techniques must be developed to provide the necessary data. Standardization is mandatory in all phases of the effort to gather and display the needed ergonomic data: in the definition of needs and goals, in information gathering and evaluation, and in data analysis and synthesis for engineering use.

by K. H. E. Kroemer

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Publ: HS-025 238, "Human Factors Society Annual Meeting (22nd) Proceedings," Santa Monica, Calif., 1978 p680-3 1978; 16refs

Meeting held in Detroit, Mich., 16-19 Oct 1978. Abridged from a paper submitted to NBS Center for Consumer Product Technology.

Availability: In HS-025 238

HS-025 264

AUTOMOBILE SAFETY REGULATION: TECHNOLOGICAL CHANGE AND THE REGULATORY PROCESS

The history of automobile safety regulation since 1966 is viewed as an attempt to substitute public decisions on the design of new automobiles for private decisions. The focus of the examination is on the problems which confront regulators in the National Hwy. Traffic Safety Administration (NHTSA) in their attempt to affect the design and performance of automobiles and on the effect of Federal regulation on automotive technology. Several inherent problems in developing the technical requirements in proposals for new standards and in judging the desirability of proposals have not been fully resolved by NHTSA. These problems have had a detrimental effect on the number and quality of standards promulgated since the initial set. The agency's efforts in developing new technology have also faced problems and have so far not contributed to its standards. In order for NHTSA to have a beneficial effect on automobile design, the agency must develop performance requirements as a basis for standards; it must analyze and predict the impact of adopting a proposed standard and must decide whether or not to adopt it, and must be willing to defend this decision against political and legal challenges. Experience in the past 10 years of automobile safety regulation shows that the process of regulation needs improvement in the areas of accident sampling, investigation, and analysis; of the realism of NHTSA's performance measures, especially crashworthiness; and of research and development strategy (expansion to promote safety innovations). It is recommended that NHTSA be more explicit about the choice between costs and risk reductions, and about the lack of full information on cost and safety impacts; that large scale field tests be made with modified automobiles in normal use; and that more information be supplied to the public about NHTSA decisions and the data upon which they are based.

by Philip A. Lorang; Lawrence H. Linden

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NSF-OEP-76-00284

Rept. No. MIT-EL-77-036WP; 1977; 180p refs

Availability: Corporate author

HS-025 265

TRAFFIC FLOW CONTROL AT AN INTERSECTION BY MEANS OF SIGNAL SETTING DURATION. STATE-SPACE ANALYSIS

A mathematical model of traffic flow at a signalized intersection is presented that forms the mathematical basis for the analysis of traffic flow control by means of signal duration setting. The result of this analysis is a definition of interdependence among the signal-setting duration, cycle, traffic flow volume, and saturation flow. In the context of this interdependence, the problem of the determination of signal duration in the fixed-time mode of signal operation at an intersection is considered. All considerations are deduced by the methodology of state-space analysis of dynamic systems. This presentation represents a contribution not only to the traffic flow theory but to the system theory as well, with future application to a computerized traffic system.

by F. M. Turcinhodzic

Publ: Transportation Research v12 n6 p411-8 (Dec 1978) 1978; 13refs

Availability: See publication

HS-025 266

ESTIMATION OF TRAFFIC VARIABLES USING A LINEAR MODEL OF TRAFFIC FLOW

Estimation of traffic velocity and the number of vehicles on adjacent sections of a limited-access highway is examined. The method proposed and evaluated is based upon application of Kalman Filtering Methods to a linear-state model of traffic flow. The estimator utilizes velocity and flow measurements at selected points along the highway. The flow measurement is a nonlinear function of the state variables and necessitates linearization about the one-step-ahead prediction of the state (extended Kalman Filter) or about nominal values of the state variables. It is shown that performance of this method using Lincoln Tunnel (New York City) data is comparable in either case to that of methods previously reported (Gazis and Knapp, 1971, and Knapp, 1973), and provides a substantial savings in data storage requirements. Also demonstrated is the fact that flow at an internal measurement point may be deleted from the observation vector without a serious effect on performance; this would arise, for example, if control of traffic were to be exercised at such a point.

by Dipankar Ghosh; C. H. Knapp

Publ: Transportation Research v12 n6 p395-402 (Dec 1978) 1978; 6refs

Availability: See publication

HS-025 267

TRAFFIC SURVEILLANCE AND DRIVER BEHAVIOUR

The "memory" effect of traffic surveillance on drivers exceeding the speed limit was investigated in Sweden in four sets of experiments. The memory effect is the condition where a driver returning to a point or area where he has previously observed surveillance might adjust his behavior without surveillance. An experimental design was implemented to investigate the existence, magnitude, and duration of the memory effect on speed behavior for surveillance by radar, helicopter,

marked police car, and unmarked police car with camera. The design used was of the traditional before/after type with statistical controls. Analysis of the data collected during the field studies showed that the memory effect is statistically significant for at least 10 days for surveillance using radar, helicopters, and marked police cars. Surveillance with unmarked police cars has little or no memory effect.

Transport Res. Delegation, Sveavagen 166, 14 tr. S-113 46
Stockholm, Sweden
1979; 28p 3refs
Availability: Corporate author

HS-025 268

BICYCLE-SAFE GRATE INLETS STUDY. VOL. 3: HYDRAULIC CHARACTERISTICS OF THREE SELECTED GRATE INLETS IN A SUMP CONDITION. FINAL REPORT

Hydraulic and debris tests were conducted to determine the capacity and debris-handling capabilities of three sump grate designs placed in a sump condition (low point of a vertical curve), the three designs having been identified previously as hydraulically-efficient and bicycle-safe. The designs include the following: parallel-bar grate with 3/4 in (19 mm) spacers (smaller than the 7/8 in (22 mm) narrowest bicycle tires), designated the P - 1-1/8, because the center-to-center spacing of the parallel bars was 1-1/8 in (28.6 mm); parallel-bar grate with a 1 7/8 in (47.6 mm) center-to-center spacing of the parallel bars, and transverse rods spaced 4 in (102 mm) on centers, designated P - 1-7/8 - 4; and curved-vane grate, designated CV - 3-1/4 - 4-1/4, because the longitudinal bars were spaced 3 1/4 in (82.6 mm) center-to-center and the transverse, curved vane members were spaced at a nominal 4-1/4 in (108 mm). Six sizes (from 1.25 ft by 2 ft (0.38 m by 0.61 m) up to 3 ft by 4 ft (0.91 m by 1.22 m)) of each sump grate design were tested on a 1:2 scale model representing a sump condition. The grates were tested using a longitudinal slope of 0.2% and roadway cross slopes of 1/48, 1/24, and 1/16 with gutter flows represented up to 30 cu ft/s (0.85 cu m/s). The results of the sump tests should prove to be very helpful to highway design engineers (numerous design curves provided to aid the engineer with sump grate selection). Although, in general, the three sump grate designs had similar flow capacities, once they became submerged, the P - 1-7/8 - 4 design had the highest inlet flow capacity for a given flow depth, followed by the P - 1-1/8 and the CV - 3-1/4 - 4-1/4. The debris-handling capabilities of the sump grates were not as good as would be expected. In fact, once the smaller-sized sump grates became plugged, the remainder of the debris was diverted through the curb opening resulting in a higher debris efficiency than that for the large size sump grates which plugged with more debris. Average efficiencies of the six sump grate sizes based on 15-minute performance showed the P - 1-1/8 sump grate to be the least efficient for continuous-grade tests but to excel for sump conditions.

by P. H. Burgi
Department of Interior, Bureau of Reclamation, Denver, Colo.
80225
FHWA-PO-5-3-0166
Rept. No. FHWA-RD-78-70; 1978; 80p 2refs
Availability: NTIS

HS-025 269

TIRE ROUNDUP

General information on automobile tires is presented for the consumer, and two methods for estimating degree of tire wear are illustrated and explained. Differences among bias, belted, and radial tires are explained, with illustrations of bias-ply, bias-belted, radial ply, and winter tire treads as well as of the difference in construction between bias-ply and radial tires. Retreads are mentioned as an alternative to the purchase of new tires. Tire size-service designation codes (numeric, alphanumeric, metric) are explained and presented in a comparison table. Tire gauge information includes how to convert psi to kilo Pascals for inflation pressures and to convert lb to kg for load factors. The trend toward lower, wider tires ("low-profile" tires) is mentioned, and the importance of not mixing tire sizes or profiles is stressed. Tire aspect ratios (or profiles) comparing the ratio of a tire's width to its height are shown graphically. Considerations in the use of radial tires indicates that radials are not as well suited to certain types of heavy use as belted tires; that they are not to be installed on a car with a worn or damaged suspension; and that they are always to be used in a complete set. Patterns of automobile tire rotation (including diagram by Tire Industry Safety Council), inflation, load-overload, and inspection of tires are discussed individually. A list of tire tips is presented which should aid the consumer in getting a warranty's worth of tire mileage. A question-and-answer section on radial tires follows. Also provided in a special section describing all-season radial tires, are symbols designating this type of tires.

Publ: Driver v12 n8 p1, 3-10 (Jan 1979)
1979
Availability: See publication

HS-025 270

MOPEDS...WILL THE REGULATIONS TIGHTEN UP?

Lack of consistency in the states' dealings with an ever increasing number of mopeds, has led the National Hwy. Traffic Safety Administration (NHTSA) to propose a series of recommended moped regulations to the states. These recommendations, while not proposed highway safety standards, were published in the Oct 1978 Federal Register and will become effective in Nov 1979, after public comments. The first of NHTSA's proposals is that mopeds be registered and licensed so as to be distinguished clearly from bicycles and motorcycles. It is proposed that moped operators have the same insurance requirements and financial liability as drivers of other motor vehicles, and should be required to hold operators' licenses, meeting the same age and testing requirements as operators of other motor vehicles. It is recommended that a handbook on moped legal requirements and safe-driving practices be prepared, that motorcycle safety education programs include information on moped operation, and that high school and adult driver education courses incorporate such information. NHTSA recommends that passengers be prohibited on mopeds unless the vehicles are designed specifically to carry passengers, and that all moped drivers be encouraged to make themselves highly visible to other traffic and be required to

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wear safety helmets. It is also recommended that mopeds be prohibited on high-speed, limited-access highways.

Publ: Driver v12 n8 p13 (Jan 1979)

1979; 2refs

Data provided by Insurance Inst. for Hwy. Safety, and Moped Assoc. of America.

Availability: See publication

HS-025 271

ACHTUNG. OR "IT'S A LONG WAY TO FRIEDRICHSHAFEN" [EDUCATING MILITARY PERSONNEL ABOUT TRAFFIC SIGNS AND CONDITIONS IN WEST GERMANY]

Since the U.S. Air Force's 335th and 336th Tactical Fighter Squadrons are dual-based (at Seymour Johnson AFB in North Carolina, and at Ramstein Air Base in West Germany), military personnel of these units are educated about European driving conditions, especially traffic signs, with special reference to those in West Germany. As part of its ongoing safety program to reduce the potential driving hazards for American military personnel stationed in Europe, Seymour Johnson AFB posts various international road signs adjacent to their American counterparts, when counterparts exist, as well as traffic signs specific to West Germany. Personnel at Seymour Johnson also receive instruction on the meaning of other international road signs. The 86th Tactical Fighter Wing (the host unit at Ramstein) presents a multimedia orientation briefing for Ramstein, Germany, and the surrounding area to Seymour Johnson personnel. Each unit's safety officer coordinates the dual-base education. Classes are taught by the transportation squadron driver's school to key personnel who might drive in West Germany.

by Virgil Kicker; Ronald Fuchs

Publ: Driver v12 n8 p16-7 (Jan 1979)

1979

Availability: See publication

HS-025 272

TIPS FOR THE NEWER DRIVER [INTERVIEW WITH CALIFORNIA HIGHWAY PATROL OFFICER, JOHN SAVAGE]

The young driver (under 18 years of age) is discussed from the point of view of a California Hwy. Patrol officer. The police look for young drivers more than older drivers, and the young drivers have to pay closer attention to traffic laws than older drivers in order to avoid tickets. Law enforcement personnel notice that younger drivers are always in a hurry. Following too closely, failure to yield, making a bad lane change, or running a light have excessive speed as their basic cause. The best way for the young driver to avoid tickets is to slow down. Many newer drivers are not aware that in some states having alcoholic beverages in a car is an offense, even if the containers are not open, if the driver is under 21. In many states it is illegal to modify an exhaust system so that the vehicle noise is amplified or increased, a practice popular among newer drivers. By coupling excessive speed with inexperience, the result is often a driver who hits things. In this regard, the police officer sees hit-and-run accidents involving young drivers, the type of accident where the driver hits a parked car because of unfamiliarity with his vehicle or with judgment of distances. It is stressed that the driver should stay at the scene

in such cases and exchange information with the owner of the other vehicle, to avoid being charged with a hit-and-run offense. Many newer drivers are not aware of their automotive environment (i.e. cars around, people near the street, traffic at intersections) and concentrate only on the act of driving. The young driver is advised not to focus his entire attention on the driving task.

by Rhonda Wiley

Publ: Driver v12 n8 p18-9 (Jan 1979)

1979

Availability: See publication

HS-025 273

DIESEL FUEL INJECTION: AN OPTIMUM APPROACH

In developing a strategy for optimum adaptation of a fuel injection system to a diesel engine, the engineer must select the optimization points, minimize the injection system parameters to be optimized, and determine the optimum adaptation at which all target requirements are met. Optimizing a fuel injection system involves finding and realizing the best set of tradeoffs within given restrictions. Restrictions result in requirements which are expressed in numerical values for each engine's set of engineering targets (exhaust emission limits, maximum combustion pressure, high torque, permissible combustion pressure rise, permissible exhaust temperature, and permissible injection pressure). Faced with all of these variables, the designer also must meet the additional requirement for maximum fuel economy, which is the diesel's strong suit and therefore a primary goal. A sensible approach to optimization can be made by establishing the relationship of these variables to the injection parameters. This calls for a strategy which limits the number of tests to a minimum, clearly determines the dependence of target variables on injection parameters, and makes it possible to present results in a form which permits design of the injection system to existing tolerances. A practical sequence leading to optimization of a fuel injection system includes specification of nozzle protrusion, choice of nozzle spray direction, specification of minimum orifice length and minimum sac hole volume, determination of minimum peak injection pressure, variation of the number of orifices as necessary, and final optimization of start and duration of injection. Among the factors leading to short injection duration are high discharge cross section of the injection nozzle, large plunger area and steep cam slope, small clearance volume and low elasticity of the high-pressure section, short overlap length (pintle nozzles), and high nozzle opening pressure (indirect injection engines).

Publ: Automotive Engineering v87 n2 p28-30 (Feb 1979)

1979

Based on SAE-790036 "A Strategy for Optimization of Diesel Fuel Injection System," by W. G. Wessel and E. U. Joachim.

Availability: See publication

HS-025 274

FUEL DISTRIBUTION UNAFFECTED BY MANIFOLD FILMS

Researchers at United Technologies concluded from a recent study that steady-state fuel distribution among the four cylinders of a carbureted 2.3-L, spark ignition engine is not affected by the presence of liquid films or puddles in the intake

manifold, but rather by other charge stratification effects in the intake flow process. Heretofore, fuel films were believed to induce a maldistribution of fuel among the cylinders and, during transient operation, to act as fuel sources (or sinks) which make overall fuel-air ratios (F/A) deviate from those scheduled by the carburetor. Poorer driveability, fuel economy, or emissions are among the expected results. Since attempts to characterize quantitatively the influence of intake manifold puddles or the films themselves had not been undertaken, current induction system design procedures do not satisfactorily address film-induced problems. To provide data regarding these manifold films for use in improving induction system design procedures, United Technologies Res. Center carried out a two-phase test program. In the first phase, tests of a modified 2.3-L, 4-cylinder engine were directed toward definition of the map of engine operating conditions over which wall films of appreciable magnitude exist, as determined by visual or optical techniques, and description of the species concentrations and air and fuel flow rates associated with the flow exiting each cylinder under selected test conditions. In the second phase, studies were directed toward definition of manifold wall temperature effects on the size of the film-occurrence region and on resulting F/A distributions among cylinders.

Publ: Automotive Engineering v87 n2 p35-40 (Feb 1979)
1979

Based on SAE-780944 "Manifold Fuel Film Effects in an SI Engine," by I. W. Kay.

Availability: See publication

HS-025 275

IS 0.4 G/MI OF NOX ACHIEVABLE? [NITROGEN OXIDES IN EXHAUST EMISSIONS]

After careful review of factors affecting exhaust emissions and fuel consumption, available system concepts to control those factors, and component hardware emerging in the marketplace, Bendix Corp. researchers have concluded that the exhaust emission target of 0.4 g/mi of NO_x (nitrogen oxides) may be achieved and perhaps exceeded. This analysis by the Bendix Electronics and Engine Control Systems Group has demonstrated that, via currently available technology, 0.4 g/mi of NO_x can be achieved in a 4500-lb, inertia weight vehicle, accompanied by virtually flawless driveability. According to Bendix, this accomplishment suggests that application of more advanced sensing, control, and exhaust after-treatment may result in even better performance. Vehicle downsizing and more sophisticated system control concepts should allow retention of this achievement despite increasingly stringent fuel consumption standards.

Publ: Automotive Engineering v87 n2 p42-5 (Feb 1979)
1979

Based on SAE-790175 "A Fuel Control System for 0.4 NO_x," by Robert H. Parker.

Availability: See publication

HS-025 276

CERTIFICATION TESTING VS. CUSTOMER DRIVING: A FUEL MEASUREMENT DILEMMA

It is impractical, if not impossible, to develop a fuel consumption test which properly assimilates all variables involved. Since a stable baseline is important, and Environmental Pro-

tection Agency (EPA) determinations (despite their acknowledged shortcomings) serve that purpose, extensive engineering data should be acquired before any further test or procedural changes are incorporated. Any new-car labeling procedures will have significant limitations in distinguishing among closely-related vehicles. Projections of a fleet's fuel demands require better understanding of the factors involved, as well as stable fuel-consumption determination practices. Since a driver's fuel consumption in a particular car varies widely, and differences between cars are subject to even more variables, basic questions are raised by attempts under the Energy Policy and Conservation Act (requiring a fuel economy label to be affixed to new cars, dissemination of fuel economy figures in a gas mileage guide and in manufacturer's advertising, and establishing production-volume weighted standards for manufacturers) to simplify the complexities involved in estimating new-car fuel consumption rates. There has been considerable public criticism of EPA's composite city-highway fuel consumption values as being too optimistic, but the discrepancy between actual customer fuel consumption figures and EPA composite figures has been recognized for years in governmental fuel demand projections, some of which have assumed that "in use" consumption will be approximately 12% higher than EPA values. An understanding of this relationship is important in any fuel demand projection and to car design engineers and manufacturers who are concerned with establishing the real values of design changes aimed at improving customer fuel economy. Equally important is a stable baseline, created by a test procedure which remains fixed. These needs are compatible if not confused with the difficult task of supplying simplified consumer information on expected fuel mileage.

Publ: Automotive Engineering v87 n2 p52-8 (Feb 1979)
1979; Iref

Based on SAE-780938 "A Fuel Economy Measurement Dilemma--Certification Testing vs Customer Driving," by Craig Marks.

Availability: See publication

HS-025 277

INJURIES CAUSED BY SEATBELTS IN STATIONARY VEHICLES

Since 1974, 11 cases have been treated at the National Inst. of Traumatology, in Budapest, Hungary, which involved persons who sustained injuries to the lower extremities as a result of getting their feet caught in the seat belt when leaving the car. The injuries included 9 ankle fractures, 1 fracture of the tibia and the fibula, and 1 tarsal-metatarsal/Lisfranc/dislocation. These accidents did not involve automatic seat belts. With the exception of one case, previous to the accident the seat belt had not been replaced after use, and it subsequently slipped to the bottom of the car; in the exceptional case, the accident occurred because the lower loop of the seat belt was dangling in mid-air. Only back-seat occupants were injury victims, since the misplaced seat belt, owing to its own weight, had slipped down behind the back of the front seat, just inside the car door. In some cases the lower extremity caught in the seat belt was fractured; in others, the passenger tumbled out of the car, thereby injuring the leg not caught in the belt. To prevent this injury, educating car occupants to replace their seat belts properly in the clamp before leaving the car is recommended.

by G. A. Nemes; I. G. Kerenyi

Publ: Journal of Trauma v18 n10 p736-7 (1978)
1978

Availability: See publication

HS-025 278

CAR DIESELS FOR HIGH-VOLUME PRODUCTION

Fiat is the latest European car maker to enter the diesel market on a major scale, and has introduced 2-L and 2.5-L, 4-cylinder engines as options for its 131 Mirafiori and 132 sedans. These engines are built in southern Italy by SOFIM (Franco-Italian Engine Co.) which was created in 1974 by Fiat, Alfa Romeo, and Saviem (Renault) as a joint venture. The completely new design was developed by Fiat. It is the first of a family of 3-, 4-, and 6-cylinder, high-speed automotive units available to other partners in the group. SOFIM has tooled up to make 700 engines a day by 1980 in anticipation of further rapid growth in the European diesel car market. Since the two engines are very similar except for the bore and stroke (cylinder spacings identical), much of the machining can be done on the same lines. A belt-driven, overhead camshaft was adopted, following Fiat practice with gasoline engines, simplifying the cylinder block and reducing weight and mechanical noise. The crankcase has a separate skirt section isolated by rubber gasket for noise reduction. All auxiliaries are mounted on the left side of the block, making possible a near-square iron casting that is stiff and easy to machine. Power rating of the 2.5-L diesel is 53 kW (72 hp) at 2400 rpm, with maximum torque 147 N.m (108 lb ft) at 2400 rpm. Bore and stroke are 93 mm x 90 mm for a displacement of 2445 cc, and compression ratio (CR) is 22:1. This engine is available in the Fiat 132 as an alternative to two gasoline options. The 2-L unit is offered in the Fiat 131 in place of five available gas engines, of which three are twin-cam, and also in the 132. Output is 44 kW (60 hp) at 4400 rpm with the same CR, and torque is 113 N.m (83 lb ft) at 2400 rpm. Displacement is 1995 cc with an 88-mm bore and 82-mm stroke. Weights are 235 kg and 230 kg, respectively. Specific fuel consumption of the larger engine is given as 270 g/kWh (198 g/hph) and for the smaller, 275 g/kWh (202 g/hph). On the road at steady 100 kph, the fiat 2-L 131D is credited with 6.8 l/100 km (34.6 mpg) and the 2.5-L 132D with 7.1 l/100 km (33.2 mpg). Both diesels are designed for future turbocharging.

Publ: Automotive Engineering v86 n9 p134-6 (Sep 1978)
1978

Availability: See publication

HS-025 279

REAR SUSPENSION FOR RIDE HANDLING COMPROMISE

Independent rear suspension is a feature of Opel's new Senator sedan and Monza coupe, which break with many of the American design concepts usually followed by General Motors' German subsidiary. The cars were conceived as direct competitors of Mercedes and BMW cars in Europe. Wheels on semitrailing arms are sprung by unusual, barrel-shaped "bedspring" coils that compress fully without contact between turns, eliminating a source of noise while increasing bump travel under maximum loading. The double-cone design allows a greater possible wheel deflection for a given spring height, and minimizes intrusion into the passenger space. Variable-rate characteristics of this configuration with varying coil diameters are increased by the use of tapered steel wire. A progressive rate was selected to optimize ride comfort under all conditions. Suspension arms pivot on a shallow, vee-form subframe rigidly supporting the differential. Pick-up points are spaced widely, and the overall geometry gives the arms a near-trailing movement. Consequently, changes in camber and toe-in are

said to be small, self-steering and jack-up tendencies minimal, and tire wear reduced. Pivots have metal/rubber bushes that combine longitudinal compliance for noise and vibration damping with lateral stiffness giving positive wheel location. The subframe features large anti-vibration mounts at the three attachment points. A rollbar and telescopic shock absorbers placed almost vertically, close to the wheel hubs, complete the suspension assembly. Front suspension is by MacPherson struts. Engine specifications for the Senator and Monza respectively are 2784 cc and 2968 cc, with 103 kW (140 hp) at 5200 rpm, 160 lb ft torque for the Senator, and 132 kW (180 hp) at 5600 rpm 182 lb ft torque for the Monza.

Publ: Automotive Engineering v86 n9 p137-9 (Sep 1978)
1978

Availability: See publication

HS-025 280

SIMPLIFIED PARTS LOWER CAR WEIGHT

Weight reduction was a prime aim of Saab engineers when designing the 900 hatchback sedan, a stretched version of the 99 Combi-Coupe which provides more passenger space. Although the new front-drive model is 21 cm longer than the Combi at 463 cm overall, the weight increase is only 20 kg. The 1250-kg car is actually 3% lighter, despite the higher standard of quality appointments. The body is essentially the same as the Combi's behind the A-post, but the new elongated front section extends the wheelbase by 5 cm. It has a simplified structure with fewer individual stampings, and wheel arches are designed to strengthen the seating area for the coil springs without the extra reinforcements required for the 99. There is no sheet metal in the base of the engine compartment, where the enlarged opening is braced by an aluminum cross member of top-hat section that handles steering and suspension forces. The weight of the larger (by 20%) energy-absorbing bumpers is cut by encasing the cellular structure in resilient, thermoplastic material. Saginaw power steering is used because of its aluminum casing. Some 2.5 kg was saved with a new pedal box, where both clutch and brake pedals pivot on a common frame fabricated from simple stampings. The rear beam axle is an entirely new weight-saving design derived from the 99. It has a coil-sprung, tubular main member located by Watts linkage and a Panhard rod. Lightened wheel carriers are sigotted into the axle tube, secured by a press fit and welding. Since stub axles are offset from the axle centerline, a torsional force is applied to the tube which doubles as a stabilizer bar to counter body roll on turns. Unusual dashboard construction simplifies assembly and saves weight. It combines the instrument and control panels, entire heating and ventilation system, and steering column with associated switches in one integrated, multifunction unit. These components are mounted on a hollow steel beam that bolts between the A-posts as a structural body member with impact-absorbing capability. Dash units are encased in foam moldings. With three engine options, the Saab 900 is aimed primarily at the U.S. import market, where it is expected to rival the Mercedes 280 and BMW 520 series.

by David Scott

Publ: Automotive Engineering v86 n9 p130-3 (Sep 1978)
1978

At head of title: International Viewpoints.

Availability: See publication

HS-025 281

AN EVALUATION OF THE BEHAVIOURAL MEASURES USED IN THE ARRB INSTRUMENTED VEHICLE [AUSTRALIAN ROAD RESEARCH BOARD]

Ten subjects drove the Australian Road Res. Board experimental vehicle over a section of road, while vehicle control parameters and physiological reactions were recorded. Each subject drove the section twice, once while performing a secondary task and once while not. The subjects were also given periods of secondary task performance both alone and with simple motor responses. The investigation was designed to determine the validity of using secondary task and physiological measures together, and to evaluate the selected secondary task (an auditory choice reaction task involving a subject's response to a "beep" in his left or right ear, by pressing a left or right foot pedal using his left foot only). Results indicate that the presence of a secondary task does not significantly affect parameters of vehicle control, suggesting that secondary tasks could be used more extensively in future research. Physiological measures were affected significantly by the presence of the secondary task, and therefore have little value as a measure of driver task demand when used in conjunction with the secondary task. Secondary task performance varied little between the conditions of practice and driving. Also, while the task appeared sensitive to the majority of traffic events, 40% of secondary task reactions had no obvious cause. The task appeared to be more sensitive to the motor activity component of driving than to the complete parameter of driving task difficulty. Results suggest that secondary task and physiological methods cannot be used together and that the present secondary task is only selectively sensitive to the driving task.

by Mary Armour
Australian Road Res. Board, P.O. Box 156 (Bag 4),
Nunawading, Vic., Australia 3131
Rept. No. ARRB-AIR-217-1; 1976; 20p 12refs
Project No. 217: Applications of behavioural methods to
traffic engineering practice.
Availability: Corporate author

HS-025 282

THE REACTION TIMES OF DRIVERS TO ROADSIDE OBJECTS

A pilot study of a new method for measuring driver reaction time was undertaken in Victoria (Australia) to investigate the suitability of the assumed reaction time value of 2.5 sec as currently used in road design. The verbal response times of 10 drivers to colored posts placed along the roadway were measured, and the subjects' physiological and vehicle control responses to the posts and to approaching cars on intersecting roads were recorded. An average verbal response time of 1.76 sec was recorded, although a mean reaction time 30% longer than the assumed value of 2.5 sec was recorded for one subject. Physiological responses were not consistent for all subjects. Of recorded reactions to posts, 73% occurred within 1.5 sec and 27% within 3 sec of the subject sighting the post. For the cases of cars approaching at intersections, 94% of the reactions occurred within 1.5 sec of the car entering the subject's field of view. It is suggested that the method used in this study is unsuitable for a large-scale study of driver reaction

time in the field but that it could be adapted for simulation studies.

by Mary Armour
Australian Road Res. Board, P.O. Box 156 (Bag 4),
Nunawading, 3131, Vic., Australia
Rept. No. ARRB-AIR-217-2; 1976; 17p 5refs
Project No. 217: Applications of behavioural measures to
traffic engineering practice.
Availability: Corporate author

HS-025 283

AN EVALUATION OF THE INTRODUCTION OF A PRIORITY ROAD SYSTEM IN METROPOLITAN ADELAIDE [SOUTH AUSTRALIA]

An investigation of possible traffic safety benefits resulting from the introduction of a priority road system in South Australia was conducted by measuring drivers' behavioral responses while driving a specific route in Adelaide before (May 1975), immediately after (Nov 1975), and nine months (May 1976) after the priority system had been introduced. Previously, at unsignalized intersections in South Australia, the right-of-way rule applied. When the priority system was put into effect for various routes in Metropolitan Adelaide, the major roads were designated by placing a white line across each side street, supplemented by yield or stop signs on the minor roads and priority road signs on the major roads. In this evaluation study, the subjects' physiological and vehicle control reactions were monitored, and the subjects were asked to perform a secondary task while driving. A marked decrease in apparent driving difficulty and demand was found in May 1976 compared to May 1975. It seems reasonable to assume that at least part of this effect was due to the introduction of the priority road system. Driver familiarization, climatic differences, and traffic flow changes are other possible contributing factors. On the basis of this study, it is not possible to assess the full effect of priority roads. Consideration must be given to details of other traffic engineering measures such as accident rates, journey times, and vehicle speeds, which are yet unavailable.

by Mary Armour
Australian Road Res. Board, P.O. Box 156 (Bag 4),
Nunawading 3131 Vic., Australia
Rept. No. ARRB-AIR-217-3; 1976; 55p 11refs
Project No. 217: Applications of behavioural measures to
traffic engineering practice.
Availability: Corporate author

HS-025 284

AN INVESTIGATION OF ON-THE-ROAD MEASURES OF DRIVER TASK DEMAND

Using the Australian Road Res. Board instrumented car, investigations were made of different on-the-road methods of measuring driving demand. An assessment was made of the usefulness of secondary task performance in comparison with vehicle control responses, especially to evaluate the consistency and reliability of these measurements. Six subjects drove over a route which consisted of five sections of road with varying design and traffic flow. Each subject drove the route four times under each of four conditions (performing an auditory choice reaction task, performing a verbal tapping task, performing a random light task, and performing the driving task alone). Records of driving vehicle control responses were

September 28, 1979

HS-803 541

taken. Results indicate that neither of the two methods give totally satisfactory measures. It is indicated that the secondary task methods can be sensitive to large changes in task demand but are not reliable measures of changes in driving environment. Although vehicle control parameters show some promise as discriminators between levels of task demand, a lack of consistency was noted and problems exist in interpreting results.

by Mary Armour
Australian Road Res. Board, P.O. Box 156 (Bag 4),
Nunawading 3131, Vic., Australia
Rept. No. ARRB-AIR-217-4; 1978; 54p 27refs
Related projects: 217, 247, 270, and 297.
Availability: Corporate author

HS-025 285

MODEL PEDESTRIAN SAFETY PROGRAM USERS' MANUAL

Information is presented to assist individuals or organizations in planning and creating a safer environment for pedestrians. Ideas, resources, procedures, and implementation suggestions to aid efforts to create pedestrian safety programs are provided for local neighborhood associations, civic groups, school groups, municipal, county, and state governments, highway departments, safety coordinators, and police and traffic engineering departments. As a guide, this manual identifies steps to follow to set up a pedestrian safety program and provides information to help select safety countermeasures. As a resource, it lists numerous possible solutions to safety problems and provides lists of additional references. Guidelines are developed in the following six steps: determining the extent of the pedestrian safety problem, identifying alternative solutions, selecting the best alternatives (benefit-cost analysis), implementing selected alternatives, evaluating the effectiveness of the implemented alternatives, and maintaining the pedestrian safety program. Each step is discussed in detail, and several appendices provide more detailed technical data on specific topics (data collection techniques, potential funding sources, evaluation resources, and state use of the Model Pedestrian Safety Prog.). A glossary of terms is provided.

BioTechnology, Inc.
1978; 363p refs
Sponsored by Federal Hwy. Administration. 78-6
Implementation Package.
Availability: GPO, stock no. 050-003-00335-2

HS-025 286

STATISTICS OF DELAY FOR A DRIVER POPULATION WITH STEP AND DISTRIBUTED GAP ACCEPTANCE FUNCTIONS

Studies of the behavior of a driver on a minor road waiting to merge with a main traffic stream usually use the notion of a gap acceptance function, and a model generally used for the reduction of gap acceptance data is one in which each driver has a unit step gap acceptance function, but the time of the step is distributed over the driver population. Data are now available to show that individual gap acceptance functions do not take the form of a step. In the present investigation, it is assumed that the individual gap acceptance function equals zero, but the data customarily available are reduced as if they came from a distribution of step functions. Under these cir-

cumstances, it is shown that for a single-car waiting-time problem, the mean delay is calculated correctly using either assumption of the individual gap acceptance functions. The variance of the calculated waiting time would be overestimated as would be the probability of zero delay. The capacity would be overestimated. Data available from measurements by Bottom and Ashworth (1977) suggest that the discrepancies caused by assuming step gap acceptance functions may not be too large. It is noted that the present study was predicted on the use of a negative exponential headway distribution, which is appropriate for light traffic only, and that the study is further limited to the single car delay situation.

by Dennis E. Blumenfeld; George H. Weiss
Publ: Transportation Research v12 n6 p423-9 (Dec 1978)
1978; 15refs
Availability: See publication

HS-025 287

DESIGNING AND TESTING THE HEAVIES [HEAVY-DUTY MOTOR VEHICLES]

Prompted by greater emphasis on product liability, vehicle productivity, and the use of more sophisticated componentry, U.S. heavy-vehicle (trucks and off-highway equipment) manufacturers have reevaluated their traditional development processes (building prototypes, testing the units, and rebuilding them several times before establishing new models) and have invested heavily in top-notch vehicle development programs. Today's design and testing processes are generally as lengthy as the trial-and-error methods previously utilized and are much more thorough. Most programs take from four to seven years, and consist of variable methods in setting specification targets (concerning vehicle measurements, performance, costs, life, reliability, and maintenance/repair), constructing plastic models, and clay and/or wood mock-ups, building full-scale prototypes, and evaluating test material and vehicles. Among the design criteria cited by the principal heavy-duty vehicle manufacturers are vocational requirements (e.g. driver comfort), government, state and local regulations, quality, reliability, and safety objectives, market forecast and trends, manufacturing estimates, industry guidelines, and influence of fixed facilities. Laboratory and field tests are described, including fatigue tests of various components and strain gauge applications recorded by telemetry and by minicomputer. State-of-the-art processes and techniques are being used to develop better, safer, and more productive machinery.

by John A. Stark
Publ: Truck and Off-Highway Industries v1 n1 p30-9 (Jan-Feb 1979)
1979
Availability: See publication

HS-803 541

HISTORIC (1971-1975) COST-REVENUE ANALYSIS OF THE AUTOMOTIVE OPERATIONS OF THE MAJOR U.S. AUTOMOTIVE PRODUCTS MANUFACTURERS. FINAL REPORT

A cost-revenue analysis was performed for the manufacture of automotive vehicles between 1971 and 1975 for American Motors Corp., Chrysler Corp., Ford Motor Co., and General Motors Corp. (GM). The analysis used a "top-down" methodology based principally on corporate operating statements and sup-

porting notes published in corporate annual reports and SEC 10K forms (annual reports filed by the companies with the Securities and Exchange Commission). The study entailed the disaggregation of the consolidated corporate financial data presented and the identification or estimation of data pertinent to automotive operations. These operations were examined at the following three levels of disaggregation: worldwide operations, North American (U.S. and Canada) operations, and U.S. manufacture of passenger vehicles and light trucks. The data presented for each company at each level of disaggregation include estimates of the following: revenue, pretax earnings, total costs, fixed costs, variable costs, number of units manufactured, average unit revenue, average unit variable cost, average unit variable margin, and break-even production level. It was determined that both price (revenue) and cost of cars and light trucks increased annually between 1971 and 1975; costs have increased more rapidly than revenue, resulting in decreasing profit margins during this period. Cost increases between 1971 and 1975 were due principally to increases in variable costs, which represent approximately 80% of the total cost of a vehicle. Nonvariable costs were found to vary to some extent with planned production volume. Break-even production levels generally increased until 1974, principally due to a decrease in profit margins. For the three major manufacturers, the break-even production levels decreased in 1975 vs. 1974; for AMC, there has been a continuous escalation of this figure from 1971 through 1975, the 1975 figure (600,000 vehicles) being greater than the company's maximum historic production level. GM was found to obtain the highest price per vehicle and also to have the highest profit margin; it is the only company that has shown a profit every year between 1971 and 1975 on its U.S. car and light-truck production operations.

by R. Kaiser
H. H. Aerospace Design Co., Inc., Civilian Air Terminal,
Bedford, Mass. 01730
DOT-TSC-1310
Rept. No. DOT-TSC-NHTSA-78-27; 1979; 102p refs
Rept. for Apr 1978.
Availability: NTIS

HS-803 544

HISTORICAL FINANCIAL DATA--DOMESTIC AUTOMOBILE MANUFACTURERS. FINAL REPORT

An historical financial data base was developed for the four major U.S. automobile manufacturers, focusing on the specific operations associated with production and marketing of automobiles and light trucks from 1967 to 1976. The principal accounting and reporting policies of American Motors Corp., Chrysler Corp., Ford Motor Co., and General Motors Corp. were examined. The accounts selected for analysis were annual capital investment for property, plant, and equipment; annual investment for special tools; annual operating cost of maintenance, repairs, and rearrangements; and annual expense for research and development, and for depreciation and amortization of assets. Using a process of successive disaggregation, the consolidated corporate financial statements for each manufacturer were analyzed to develop estimates of the specific automobile and light truck-related amounts. Data and information to assist in the disaggregation process were collected by means of a literature search and discussions with industry analysts. An examination of the sensitivity of each of the accounts to future changes was also performed. The data base, when combined with similarly disaggregated production, revenue, and cost time series, will lead to a better understand-

ing of the microeconomics of the production and marketing of those vehicles most likely to be affected by fuel economy regulation.

by John M. Carroll; Richard P. Schneider
Arthur D. Little, Inc., Acorn Park, Cambridge, Mass. 02140
DOT-TSC-1047
Rept. No. DOT-TSC-NHTSA-78-28; 1979; 272p refs
Rept. for Apr-Dec 1977.
Availability: NTIS

HS-803 778

CHEVROLET LUV PICKUP TRUCK WEIGHT REDUCTION BASELINE DATA. FINAL REPORT

A teardown study was conducted of the 1978 Chevrolet LUV pickup truck with 4-cylinder engine and 4-speed transmission in order to provide the National Hwy. Traffic Safety Administration with the baseline data on material use, structure, and weight. These data will be used in more detailed studies concerning the future potential of material substitution to achieve weight reductions and corresponding improvements in fuel economy. The vehicle teardown was limited to the detail necessary for projecting near-term weight reduction for automotive fuel economy studies. A complete parts list is presented which includes component description, quantity per car, total weight per car, material description, method of fabrication, and gauge thickness, including photographs of the major components.

by Jerar Andon
South Coast Technology, Inc., P.O. Box 3265, Santa Barbara,
Calif. 93105
DOT-HS-7-01790
1978; 104p
Rept. for Jul-Oct 1978.
Availability: NTIS

HS-803 780

BASELINE TEST OF COMPACT VEHICLE SIDE STRUCTURE, 25 MPH, 60 DEGREE IMPACT, TORINO-TO-VOLARE TEST NO. 2. FINAL REPORT

Test results are presented for the second of 11 tests to investigate and improve crashworthiness of compact-vehicle side structures. The test, which was run at 25 mph at a striking angle of 60 degrees, involved a 1975 Ford Torino as the bullet vehicle and a 1976 Plymouth Volare as the target vehicle. The heights of the vehicles were adjusted to ensure sill engagement. The still photographs, the electronic data in plotted form, vehicle damage sketches and tabulated pre- and post-test dimensions, accelerometer location identification and summaries of the simulated occupancy (Part 572 dummies in driver and passenger positions, restrained by lap and shoulder belt in Torino, unrestrained in Volare) data are presented, including injury criteria values. For the Torino, there was no compartment intrusion. The grille and light support structure were crushed and pushed rearward under the hood and hood movement was negligible. The forward section of the left front fender buckled; the forward side was deformed back to the rear of the fender well. For the Volare, there was damage on the left side of the vehicle from the rear of the front wheel to the 'C' pillar. Buckling of the left rocker panel was incurred along its total length, with the most severe lateral intrusion from the center of the front door to the 'B' pillar. The max-

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imum intrusion occurred at the lower part of the left front door, caused by bumper contact. The left 'C' pillar was dimpled just below roof height. The right 'B' pillar was deformed slightly outward due to lateral shift of the front-seat back.

by E. Enserink
Dynamic Science, Inc., 1850 W. Pinnacle Peak Rd., Phoenix,
Ariz. 85027
DOT-HS-5-01104
1979; 57p
Rept. for Jun 1976-Mar 1978.
Availability: NTIS

HS-803 802

EMERGENCY ACTION GUIDE FOR SELECTED HAZARDOUS MATERIALS, 1978

This guide was prepared to help emergency service personnel during the first 30 minutes of an incident involving a spill of a volatile, toxic, gaseous and/or flammable material shipped in bulk. General and specific safety procedures are provided in spill guides arranged alphabetically by hazardous material. Limited to 44 selected hazardous materials, the booklet does not provide information concerning all hazardous materials that are shipped in commerce. Each left-hand page identifies a specific hazardous material, outlines its potential hazards, and provides immediate action information for fires, spills, and first aid. This page also lists certain functions and services for those with appropriate resources and equipment. Each right-hand page specifies recommended evacuation areas and distances for protecting the public from dangerous concentrations of toxic vapors and from explosions. Where applicable, necessary water pollution controls are provided. This page also lists procedures to follow when assistance is needed or when appropriate resources and equipment are not available. To establish an evacuation area for a poisonous material, emergency service personnel need only estimate the size of the spill puddle. Illustrations are provided which offer quick reference for determining an evacuation based on spill puddle size. Exclusion distances covering ignition control and blast effects are given for certain flammable materials. The hazardous materials include the following: acrolein, acrylonitrile, ammonia, ammonia (anhydrous), boron trifluoride, bromine, carbon disulfide, chlorine, dimethylamine, dimethyl ether, dimethyl sulfate, epichlorohydrin, ethyl chloride, ethylene, ethyleneimine, ethylene oxide, fluorine, hydrocarbon fuels, hydrogen (liquid), hydrogen chloride, hydrogen cyanide/hydrocyanic acid, hydrogen fluoride, hydrogen sulfide, liquid petroleum gas, methane (liquid), methylamines (anhydrous), methyl bromide, methyl chloride, methyl ethyl ether/ethyl methyl ether, methyl mercaptan, monomethylamine, nitric acid (fuming), nitrogen tetroxide, oleum/sulfur trioxide/sulfuric acid, oxygen (liquid), phosgene, phosphorous trichloride, propane/LPG, sulfur dioxide, titanium tetrachloride, trimethylamine, and vinyl chloride.

Department of Transportation, Washington, D.C. 20590
1978; 81p 3refs
Availability: Corporate author

HS-803 804

IMPACT OF RECENT CHANGES IN THE HIGHWAY SAFETY ENVIRONMENT: A PROJECT OVERVIEW. FINAL REPORT

An overview is presented of an extensive project which was conducted to measure and analyze the effects of several major changes which evolved in the highway safety environment during the early 1970's (introduction of new safety belt systems, imposition of a national 55 mph speed, and accelerated shift from large to small cars). In all, 11 reports plus several methodologies from this project deal with the following major areas: shoulder belt usage in the population at risk, the effect of misclassification errors on estimates of seat belt effectiveness, methodology for reducing the effect of these errors, the relative effect of the lowered maximum speed limit vs. the effect of reduced exposure due to the fuel shortage, crash-worthiness differences and crash involvement differences by make, model year, and/or size of vehicle, and methodologies for examining precrash factors in highway accidents. This overview presents the major findings in each of these six areas on a study-by-study basis, along with an overall summary of the project effort. Implications of the findings for National Hwy. Traffic Safety Administration current and future programs are indicated. An overriding conclusion from the project effort has been the need for more detailed and accurate accident and exposure data, both at the state and national level. The Hwy. Safety Res. Center had for its use accident tapes originating from statewide police accident reports. These reports contained information on the vehicle identification number, vehicle damage severity, seat belt usage, injury level, and other required data. There was also, an avenue for obtaining vehicle-specific annual mileage estimates through North Carolina inspection receipts. The data were not entirely satisfactory, particularly with respect to vehicle exposure before, during, and after the energy crisis.

by Jane C. Stutts; Donald W. Reinfurt
University of North Carolina, Hwy. Safety Res. Center,
Chapel Hill, N.C. 27514
DOT-HS-4-00897
1978; 53p 15refs
Rept. for 1 Jul 1974-31 May 1978.
Availability: Corporate author

HS-803 811

MOTORCYCLE ACCIDENT CAUSE FACTORS AND IDENTIFICATION OF COUNTERMEASURES. SUMMARY STATUS REPORT

Key findings to date are summarized for a study being conducted by the Univ. of Southern California for the National Hwy. Traffic Safety Administration on motorcycle accidents occurring between 1976 and 1978 in the Los Angeles area. Preliminary current findings are based on an analysis of 899 on-scene, in-depth motorcycle accident investigations. The study, to be completed late in 1979, will also include the compilation of over 3600 police accident reports and the collection of motorcycle exposure information. A summary is presented of general accident characteristics, helmet effectiveness (injury severity distributions for helmeted and nonhelmeted riders), driver characteristics, and motorcycle factors. The preliminary findings reconfirm that dramatic gains in motorcycle safety can be achieved if motorcyclists wear helmets and if

cyclists and their motorcycles are made as conspicuous as possible.

National Hwy. Traffic Safety Administration, National Center for Statistics and Analysis, Washington, D.C. 20590
1979; 6p
Summary of key findings in study being conducted by Univ. of Southern California under contract DOT-HS-5-01160.
Availability: Corporate author

HS-810 338

REMARKS BEFORE THE ADVERTISING CLUB OF WASHINGTON, JANUARY 9, 1979, WASHINGTON, D.C.

The American consumer is concerned about improved safety in motor vehicles, maximum feasible fuel economy, and efficient automobile repair. A recent survey sponsored by the National Hwy. Traffic Safety Administration (NHTSA) showed that the American consumer considers safety and safety features of major importance in deciding what kind of car to buy (72% of respondents), topped only by cost (85%), gas mileage (77%), and repair record (75%), in terms of importance. By a two to one margin, the people surveyed think that the government should require auto makers to develop automatic passenger crash safety equipment rather than encourage greater seat belt use. Two out of three people think that automobiles should be built with as many safety features as possible. Other earlier polls on automobile safety have shown that these survey results are a consistent reflection of the public's support for auto safety and for automatic crash protection. The auto industry continues to manufacture vans and light trucks without many of the well-known and obvious safety features because these vehicles are exempt from government safety regulations. It is suggested that the automotive dealers, as the link between the public and the manufacturers, could serve as the public's advocate to seek basic improvements in the industry. NHTSA recently disclosed that auto repairs cost the American public an unnecessary \$20 billion a year, partly due to unnecessary, inadequate, or faulty repairs by the repair industry, partly to bad automotive design, and partly to consumer's ignorance or neglect of maintenance needs. The auto industry, particularly the dealers, can take steps to aid consumers in purchasing and servicing their cars, including the following: treating the customer as if he wants to learn about auto safety; emphasizing dealer concern for safety of customers; encouraging the use of restraints; aiding NHTSA in investigating potential safety-related defects by participating in Parts Return Prog.; relaying safety-defect information received from customers to NHTSA Hotline; distributing service bulletins and responding to recall notices; using consumer information in advertising; and looking at the industry from the perspective of the consumer.

by Joan Claybrook
National Hwy. Traffic Safety Administration, Washington, D.C. 20590
1979; 14p 4refs
Availability: Corporate author

HS-900 019

FINANCIAL MANAGEMENT OF STATE HIGHWAY SAFETY PROGRAMS. PARTICIPANT MATERIALS

Materials are presented to be used by participants in a 3 1/2 day course in the financial management of State Hwy. Safety Programs (HSP's). The materials support each of the following 14 classroom sessions: introduction and history of highway safety; HSP planning; HSP costing activities; application session--"planning"; procurement; pre-work conference; financial management systems; application session--"initiating"; property management; grant administration; audits; application session--"administering"; evaluation, grant payment, and close-out; and application session--"closing". The following format is used as support for each session: session overview (narrative description of the subject matter to be covered during the session), classroom support material (group of materials used to support instruction by supplying examples of recommended forms, problems to be solved during class, and data needed to complete instructional exercises), instructional aids (copies of the visual aids used by the instructor), and references (bibliographic entries identifying the sources consulted in formulating the classroom sessions). The five primary methods of instruction used in the course are presentation, exercise, role-playing, group discussion, and problem-solving.

by Kenard McPherson
Dunlap and Associates, Darien, Conn.; National Public Services Res. Inst., Alexandria, Va.
DOT-HS-7-01731

1978; 276p refs
"Clearinghouse Training Materials. Subject: State Highway Safety Program Financial Management. Format: Participant materials. Type of audience: Financial Managers." See also HS-900 019.

Availability: NHTSA General Services Div.

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AN EVALUATION OF THE BEHAVIOURAL MEASURES USED IN THE ARRB INSTRUMENTED VEHICLE [AUSTRALIAN ROAD RESEARCH BOARD]
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Australian Road Res. Board, P.O. Box 156 (Bag 4), Nunawading, 3131, Vic., Australia

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Australian Road Res. Board, P.O. Box 156 (Bag 4), Nunawading 3131 Vic., Australia

AN EVALUATION OF THE INTRODUCTION OF A PRIORITY ROAD SYSTEM IN METROPOLITAN ADELAIDE [SOUTH AUSTRALIA]
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Australian Road Res. Board, P.O. Box 156 (Bag 4), Nunawading 3131, Vic., Australia

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BioTechnology, Inc.

MODEL PEDESTRIAN SAFETY PROGRAM USERS' MANUAL
HS-025 285

Brookhaven National Lab., Dept. of Energy and Environment, Upton, N.Y. 11973

POTENTIAL FUEL CELL SYSTEMS FOR TRANSPORTATION APPLICATIONS
HS-025 097

Bundesanstalt fur Strassenwesen, Postfach 51 05 30, 5 Cologne 51, Germany

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California Dept. of Motor Vehicles, Res. and Devel. Section, Sacramento, Calif.

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SEPOWER FOR ALTERNATE-ENGINED CARS
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- Chrysler Corp., Detroit, Mich.**
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- Chrysler Corp., Huntsville Electronics Div.**
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- Colt Industries, Crucible Res. Center, P.O. Box 88,
Pittsburgh, Pa. 15230**
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- Coordinating Res. Council, Motor Road Test Group, 30
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- Coordinating Res. Council, Motor Volatility Group, 30
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- Department of Interior, Bureau of Reclamation, Denver,
Colo. 80225**
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- Dunlap and Associates, Darien, Conn.**
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HS-900 019
- Dynamic Science, Inc., 1850 W. Pinnacle Peak Rd.,
Phoenix, Ariz. 85027**
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Mich. 48121**
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Mich.**
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- General Electric Co., Corporate Res. and Devel.,
Schenectady, N.Y.**
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General Motors Res. Labs.

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**General Motors Res. Labs., Electrical Engineering Dept.,
Warren, Mich. 48090**

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General Motors Res. Labs., Warren, Mich.

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**Governor's Office of Highway Safety, 131 W. Wilson St.,
Suite 803, Madison, Wis. 53702**

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(INSTRUCTOR'S HANDBOOK)

HS-025 139

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**H. H. Aerospace Design Co., Inc., Civilian Air Terminal,
Bedford, Mass. 01730**

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**Hawaii Dept. of Transportation, Traffic engineering
Section**

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**Highway Loss Data Inst., Watergate 600, Washington,
D.C. 20037**

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Hitachi, Ltd., Japan

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Human Factors Res., Inc., Goleta, Calif.

EFFECT OF HEADLIGHT ILLUMINATION ON
DRIVER BEHAVIOR

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**Human Factors Society, Inc., P.O. Box 1369, Santa
Monica, Calif. 90406**

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CALIFORNIA, OCTOBER 17-20 1977

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Indian Chain Co., Calcutta, India

ILLUMINATION LEVELS AND PERFORMANCE OF
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THE RELATIONSHIP BETWEEN DRIVER VISION
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Institute for Behavioral Res., Inc., Silver Spring, Md.

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**Institute for Road Safety Res. SWOV, P.O. Box 71, 2270
AB Voorburg, Netherlands**

TEN YEARS ROAD SAFETY IN THE NETHERLANDS

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Intel Corp.

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HS-025 116

**J. D. Palmer Associates Engineering Ltd., London, Ont.,
Canada N6B 1B7**

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**Kansas State Univ., Dept. of Industrial Engineering,
Manhattan, Kans. 66506**

MAXIMAL PEDAL FORCES EXERTABLE BY WEAK
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**Kansas State Univ., Dept. of Industrial Engineering,
Manhattan, Kans.**

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Cambridge, Mass. 02139**
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Mass. 02139**
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- Minicars, Inc.**
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- Motorists Information, Inc., 519 New Center Bldg.,
Detroit, Mich. 48202**
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Washington, D.C. 20590**
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Center for Statistics and Analysis, Washington, D.C.
20590**
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Traffic Safety Programs, Washington, D.C. 20590**
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Washington, D.C. 20590**
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Accident Investigation, Washington, D.C. 20594**
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MORBIDITY AND MORTALITY ASSOCIATED WITH
HELMET-WEARING AMONG MOTORCYCLISTS
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North Dakota State Dept. of Health

MORBIDITY AND MORTALITY ASSOCIATED WITH
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Ontario Ministry of Transportation and

Communications, Res. and Devel. Div., Canada
WINTER MAINTENANCE PRACTICE AND RESEARCH
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Organisation for Economic Co-operation and Devel.,

Road Res. Group on Driver Education and Training, 2,
rue Andre-Pascal, 75775 Paris Cedex 16, France
DRIVER INSTRUCTION

HS-025 123

Organisation for Economic Co-operation and Devel.,

Road Res. Group on Prevention of Accidents to Users of
Two-Wheeled Vehicles, 2, rue Andre-Pascal, 75775 Paris
Cedex 16, France

SAFETY OF TWO-WHEELERS

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Purdue Univ.

APPLIED AUTOMOTIVE ELECTRONICS

HS-025 225

**Robert Bosch G.m.b.H., 7000 Stuttgart 30, Federal
Republic of Germany**

ELECTRONIC APPLICATIONS TO THE AUTOMOBILE
BY ROBERT BOSCH GMBH

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RCA Labs.

THE NEAR-TERM PROSPECT FOR AUTOMOTIVE
ELECTRONICS: MINICARS' RESEARCH SAFETY
VEHICLE

HS-025 224

RCA Labs., Princeton, N.J. 08540

AUTOMOTIVE ELECTRONICS FROM AN R AND D
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GINEER'S VIEWPOINT

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Society of Automotive Engineers, Inc., 400

Commonwealth Dr., Warrendale, Pa. 15096

DESIGNING FOR AUTOMOTIVE CORROSION
PREVENTION. PROCEEDINGS OF A CONFERENCE
HELD IN TROY, MICHIGAN, NOVEMBER 8-10, 1978

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DEARBORN, MICHIGAN, SEPTEMBER 25-27, 1978

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**South Coast Technology, Inc., P.O. Box 3265, Santa
Barbara, Calif. 93105**

CHEVROLET LUV PICKUP TRUCK WEIGHT REDUC-
TION BASELINE DATA. FINAL REPORT

HS-803 778

Southern California Res. Inst., Los Angeles, Calif.

CHANGES IN DRIVER STEERING CONTROL WITH
LEARNING

HS-025 254

**Southwest Res. Inst., 3600 Yoakum Blvd., Houston, Tex.
77006**

EPIDEMIOLOGIC STUDY OF THE EFFECTS OF AU-
TOMOBILE TRAFFIC ON BLOOD LEAD LEVELS

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Statens vag- och trafikinstitut (VTI), Fack, S-58101

Linköping, Sweden

SPRAY PROTECTORS TESTING OF EFFICIENCY
[TRUCK SPLASH AND SPRAY SUPPRESSION]

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Stevens Inst. of Tech., Hoboken, N.J.

COMMONPLACE HUMAN FACTORS PROBLEMS EX-
PERIENCED BY THE COLORBLIND--A PILOT
QUESTIONNAIRE SURVEY

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Systems Technology, Inc., Hawthorne, Calif.

ALCOHOL EFFECTS ON DRIVER RISK TAKING

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**Systems Technology, Inc., 13766 S. Hawthorne Blvd.,
Hawthorne, Calif. 90250**

METHODS OF REDUCING THE SPLASH AND SPRAY
HAZARD OF LARGE TRUCKS. FINAL REPORT

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METHODS OF REDUCING THE SPLASH AND SPRAY
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A COST-EFFECTIVENESS EVALUATION OF DEVICES
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FECTS OF LARGE TRUCKS. FINAL REPORT

HS-025 093

Tandy Communication's Co., Fort Worth, Tex.

ILLUMINATION LEVELS AND PERFORMANCE OF
PRACTICAL VISUAL TASKS

HS-025 166

**Texas A. and M. Univ., Dept. of Industrial Engineering,
College Station, Tex. 77843**

VIBRATION, PERFORMANCE, AND PERSONALITY

HS-025 169

Texas Dept. of Public Safety, Austin, Tex. 78773

TEXAS MOTOR VEHICLE LAWS. 1977-1978

HS-025 112

**Texas Instruments Inc., Electrochemical and Corrosion
Lab., Attleboro, Mass. 02703**

CHEMISTRY OF THE AUTOMOTIVE ENVIRONMENT

HS-025 179

Texas Instruments Inc., Houston, Tex.

TI [TEXAS INSTRUMENTS] VIEW OF AUTOMOTIVE
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**Texas Tech Univ., Dept. of Industrial Engineering,
Lubbock, Tex.**

MALE-FEMALE DIFFERENCES IN VARIABLES AF-
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REACH PROFILES FOR MALES AND FEMALES
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TIONS

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Texas Tech Univ., Lubbock, Tex.

EFFECTS OF VIBRATION ON HUMANS: PERFORMANCE DECREMENTS AND LIMITS

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SEATING, CONSOLE AND WORKPLACE DESIGN: SEATED OPERATOR REACH PROFILES

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SEATING, CONSOLE, AND WORKPLACE DESIGN: INTEGRATION OF LITERATURE AND ACCOMMODATION MODEL

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Transport and Road Res. Lab., Access and Mobility Div., Crowthorne, Berks., England

CYCLE OWNERSHIP AND USE IN GREAT BRITAIN

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Transport and Road Res. Lab., Construction and Maintenance Div., Crowthorne, Berks., England

ROAD SURFACE IRREGULARITY AND VEHICLE RIDE. PT. 1. VARIATION AND INTERPRETATION OF RIDE MEASUREMENTS

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ROAD SURFACE IRREGULARITY AND VEHICLE RIDE. PT. 2. RIDING COMFORT IN CARS DRIVEN BY THE PUBLIC

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Transport and Road Res. Lab., Transport Engineering Div., Crowthorne, Berks., England

THE WIND-AVERAGED DRAG COEFFICIENT APPLIED TO HEAVY GOODS VEHICLES

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Transport Canada, Road Safety Unit, Downsview, Ont., Canada

EFFECTS OF FUNCTIONAL SEPARATION AND LOW LEVELS OF BLOOD ALCOHOL ON THE RESPONSE TO AUTOMOBILE REAR-SIGNAL INFORMATION

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Transport Res. Delegation, Sveavagen 166, 14 tr. S-113 46 Stockholm, Sweden

TRAFFIC SURVEILLANCE AND DRIVER BEHAVIOUR

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U.S. Army Natick Res. and Devel. Command, Natick, Mass.

ANTHROPOMETRY OF WOMEN OF THE U.S. ARMY

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Union Carbide Corp., Home and Automotive Products Div., Tarrytown, N.Y.

COOLING SYSTEM CORROSION IN RELATION TO DESIGN AND MATERIALS

HS-025 186

Univ. of Dayton Res. Inst., Dayton, Ohio 45469

INTERCORRELATIONS OF ANTHROPOMETRIC MEASUREMENTS: A SOURCE BOOK FOR USA DATA. FINAL TECHNICAL REPORT

HS-025 175

Universite de Montreal, Ecole Polytechnique

SELECTION AND USE OF DE-ICING CHEMICALS AND ABRASIVES IN NORTH AMERICA AND OVERSEAS

HS-025 178

University of Guelph, Guelph, Ont., Canada

THE ROLE OF VEHICLE CHARACTERISTICS IN DRIVERS' PERCEPTION OF AUTOMOBILE VELOCITY

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University of Illinois, Champaign, Ill.

REVIEW OF EFFECTS OF ALCOHOL AND OTHER LICIT DRUGS ON DRIVING-RELATED PERFORMANCE

HS-025 253

University of Michigan, Hwy. Safety Res. Inst., Ann Arbor, Mich.

ANTHROPOMETRIC CONSIDERATIONS IN HUMAN IMPACT TOLERANCE RESEARCH

HS-025 256

University of Michigan, Hwy. Safety Res. Inst., 2901 Baxter Rd., Ann Arbor, Mich. 48109

ANALYTICAL STUDY OF MATHEMATICAL MODELS OF THE MOTOR VEHICLE SYSTEM: PHASE 3. FINAL REPORT

HS-025 119

University of North Carolina, Hwy. Safety Res. Center, Chapel Hill, N.C. 27514

A CATEGORICAL ANALYSIS OF THE RELATIONSHIP BETWEEN VEHICLE WEIGHT AND DRIVER INJURY IN AUTOMOBILE ACCIDENTS. FINAL REPORT

HS-025 099

IMPACT OF RECENT CHANGES IN THE HIGHWAY SAFETY ENVIRONMENT: A PROJECT OVERVIEW. FINAL REPORT

HS-803 804

University of Oklahoma, Norman, Okla.

A STUDY OF POST-CRASH BUS EVACUATION PROBLEMS

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AUDITORY AND BIOMECHANICAL PERFORMANCE REQUIREMENTS FOR MOTORCYCLE HELMETS

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University of South Dakota, Driver Behavior Lab., Vermillion, S. Dak.

THE SPECIFIC DETERRENT EFFECT OF ASAP [ALCOHOL SAFETY ACTION PROJECTS] EDUCATION AND REHABILITATION PROGRAMS

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University of Southern California, Traffic Safety Center

DRIVER PERFORMANCE AND FUEL ECONOMY

HS-025 252

University of Toronto, Ont., Canada

CHANGES IN DRIVER STEERING CONTROL WITH LEARNING

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University of Vermont, Dept. of Psychology, Burlington, Vt. 05401

IN SITU DRIVING PERFORMANCE AND THE ALCOHOL IMPAIRED DRIVER

HS-025 171

University of Waterloo, Ont., Canada

CHANGES IN DRIVER STEERING CONTROL WITH LEARNING

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September 28, 1979

**University of Wisconsin, Dept. of Industrial Engineering,
750 University Ave., Madison, Wis. 53706**

DYNAMICS OF THE EYE AND HEAD DURING MOVEMENT BETWEEN DISPLAYS: A QUALITATIVE AND QUANTITATIVE GUIDE FOR DESIGNERS

HS-025 129

University of Wisconsin, Madison, Wis.

HUMAN PERFORMANCE VARIABILITY IN ACCIDENT CAUSATION

HS-025 249

Uppsala Universitet, Box 227, 751 04 Uppsala, Sweden
DRIVER BEHAVIOR AT INTERSECTIONS WITH REGARD TO PRIORITY RULES AND ROAD DESIGN, AN EXPLORATORY STUDY (FORARBETEENDE I GATUKORSNINGAR I RELATION TILL FORETRADESREGLER OCH VAGUTFORMNING, EN EXPLORATIV STUDIE

HS-025 227

**Vehicle Equipment Safety Commission, Suite 908, 1030
15th St., N.W., Washington, D.C., 20005**

MINIMUM REQUIREMENTS FOR CONSTRUCTION AND EQUIPMENT OF MOPEDS. REGULATION VESC-17

HS-025 120

**Vehicle Equipment Safety Commission, Suite 908, 1030
15th St., N.W., Washington, D.C. 20005**

MINIMUM REQUIREMENTS FOR CONSTRUCTION AND EQUIPMENT OF SPECIAL MOTOR VEHICLES. REGULATION VESC-12

HS-025 121

**Virginia Hwy. and Transportation Res. Council,
Charlottesville, Va.**

EVALUATION OF THE PERFORMANCE OF PORTABLE PRECAST CONCRETE TRAFFIC BARRIERS

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REPEAL AND MODIFICATION OF MANDATORY MOTORCYCLE HELMET LEGISLATION

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MOPEDS AND MOPED LEGISLATION

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THE USE OF THE FATAL ACCIDENT REPORTING SYSTEM (FARS) IN EVALUATING CHARACTERISTICS OF VIRGINIA TRAFFIC FATALITIES

HS-025 260

Walker Mfg. Co., Grass Lake, Mich.

MATERIALS, DESIGN AND CORROSION EFFECTS ON EXHAUST-SYSTEM LIFE

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Wayne State Univ.

APPLIED AUTOMOTIVE ELECTRONICS

HS-025 225

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